creative computing

January 1980
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the #1 magazine of computer applications and software

Artificial Intelligence: The Unending Debate
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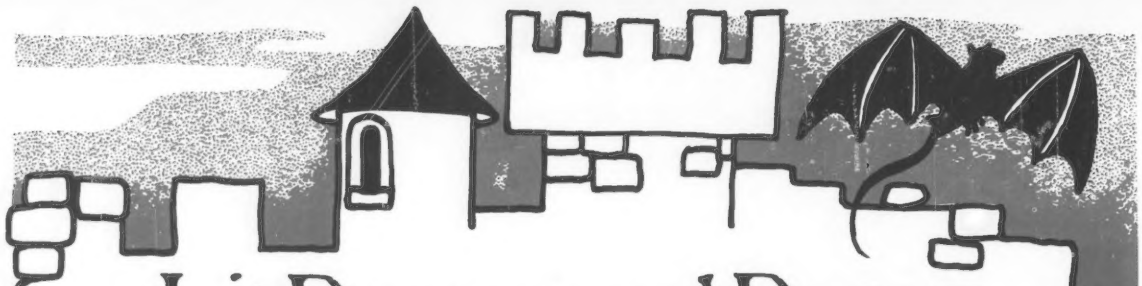

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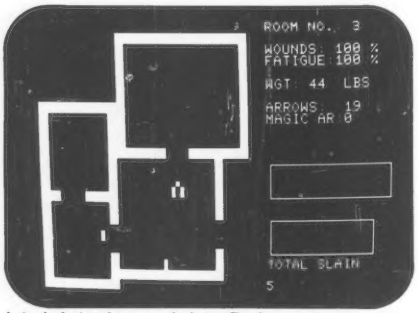

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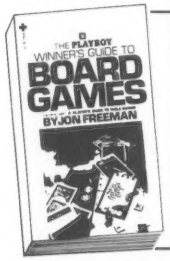

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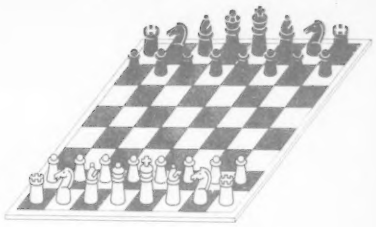

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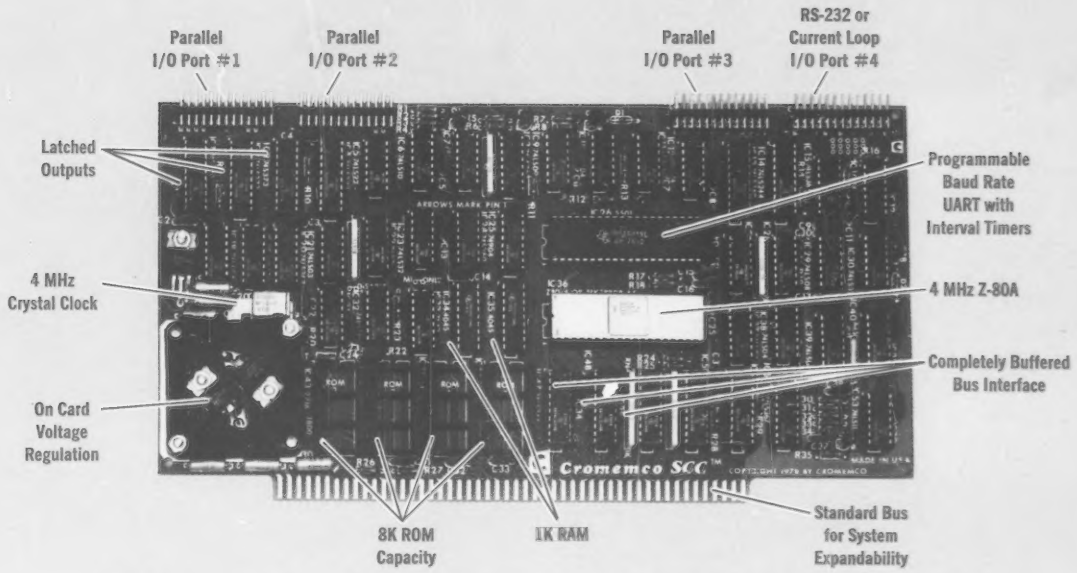

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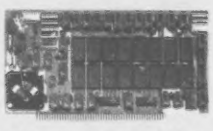

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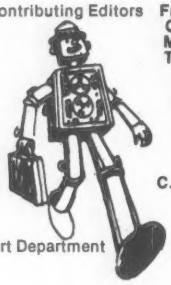

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The Cover

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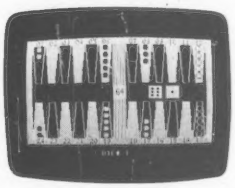

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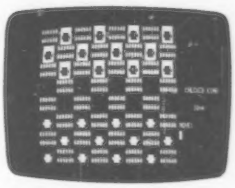

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The hardware consists of a DEC PDP-11/34 with 128K of memory, a CDC dual disk unit with 130 megabytes of on-line storage, a Printronix line printer (300 lpm), and three Hazeltine 1510 terminals.

The software was written by Scribe Data Systems of Boston, Mass. It is a menu-driven package consisting of over 100 individual program modules.

When a subscription comes in over the telephone (or by mail), the terminal operator directly types in all the required information filling in the blanks in the "form" on the screen. All blanks must be filled in before the computer will "accept" the subscription so the chance for error from incomplete information is minimized. Furthermore, the system "knows" the zip codes for every state in the U.S., it can recognize illegitimate bankcard and American Express codes, and it keeps track of promotional codes so we can more wisely target our future promotions. When a subscriber moves, the system leaves a "trailer" record so that bill payments from either address will be properly credited. Address changes can be made virtually instantaneously as can renewal extensions.

Using an outside service, the average turn-around time on processing a new or renewal subscription or address change was four weeks. Occasionally, we got two-week turn-around but not infrequently it was six weeks or more. Furthermore, our service was virtually unable and/or unwilling to handle some types of transactions. One example was sending renewal reminders to gift donors -- they just couldn't seem to do it correctly. They also tended to ignore complaints because they were out of the ordinary -- name and address misspellings, for example, were rarely corrected even after repeated requests.

Our turn-around time now will be literally the time it takes to type the subscription order or address change or whatever. Furthermore, we have attempted to anticipate every type of change or transaction that might come up and provide a program module for it. (Subscribers should not expect to receive a magazine the day after an order is entered. The labels for a give issue are printed on the 12th of the month and shipped to our printer in New Hampshire. They are applied to the magazines which are mailed between the 20th and 22nd of the month preceding the cover date. Second class mail takes between five and 20 days to reach its destination, more for overseas addresses. On average then, if a subscription is entered between March 12 and April 12, it will start with the May issue which should be received in the first week of May.)

Needless to say, no conversion effort can be totally snag free. While we've tried to anticipate the possible problems, undoubtedly some will crop up that were not foreseen. Also, because of the massive conversion job, processing of any new entries (subscriptions, renewals, bill payments) will be delayed. This of course is temporary.

It is our hope that this new (and costly!) subscription fulfillment system will help us provide better and more timely service to you, our subscribers.

—DHA

et cetera

Wholesale Software

The Software Exchange, Milford, NH announces the formation of it's new software wholesaling unit called Ramworks.

The Software Exchange is a supplier of software products for the TRS-80. The Ramworks will wholesale software for all popular personal computers, including TRS-80, Apple, Sorcerer, and Pet/CBM.

A guaranteed sale and program selection service called Ramware is featured. Ramworks is planning a promotional campaign including names of all retail dealers beginning in January 1980.

CIRCLE 204 ON READER SERVICE CARD

There is no indigestion worse than that which comes from having to eat your own words.

Our Face Is Red Dept.

The striking computer graphic on the cover of the November issue was reported as being in the Westlake Art Show described in the same issue. While Ruth Leavitt had several similar pieces in the show, the particular one on the cover was not one of them. It is on exhibit at the Modern Museum of Utrecht in the Netherlands. We also did not have Ruth's current address: it is 86 Audubon Drive, Snyder, NY 14226.

We "did it" to the folks at MicroDasys in our November issue. In the chart of single board computers on page 26 we listed their board as an MD-6906 when in fact it's an MD-690b. The 6809 microprocessor is described as a 16-bit chip and it's actually an 8-bitter with 16-bit internal addressing and data manipulation capabilities. Then, on page 159, in the Compleat Computer Catalogue, we included a photo of one of their systems along with a product release from Teleray.

et cetera

The things most people want to know are usually none of their business.

Call for Papers

Second Clemson Small Computer Conference: May 21-22, 1980, Clemson university, Clemson, S.C. Papers are solicited describing applications of small computers. Of particular interest are applications in engineering, science, manufacturing, small business data processing, and education. Submit 3 copies of a 500-word summary by February 1, 1980, with final papers due April 1, 1980, to: William J. Barnett, Electrical and Computer Engineering Department, Riggs Hall, Clemson University, Clemson, S.C. 29631.

Computer Aided Graphics

The Ukrainian Institute of Modern Art, 2320 West Chicago Ave, Chicago, IL 60622, is presenting an exhibition of computer generated imagery called ART IN/ART OUT. The opening and a reception will be Friday, February 1, 1980, from 7-10:00pm. It will run through March 16. The exhibition has been coordinated and organized by William J. Kolomyjec, computer artist, Lansing, Michigan. The state of the art of the medium of computer graphics will be illustrated and the works of seventeen established computer graphic artists of national and international origin will be on display.

For further information, please call Kalina Pomirko, at (312)227-5522.

Wanted: CAI Programs For TRS-80

The Craig County (Virginia) Public Schools have recently placed Level II TRS-80's in pilot programs in both elementary and secondary schools. These machines are being used with Computer Assisted Instruction (CAI) programs and educational programs.

Because of an apparent scarcity of CAI programs, K-12, school personnel and advanced secondary students are developing such programs. This process is quite slow, however, when the ultimate objective is to offer CAI in a variety of subjects at all grade levels.

We would be glad to contact schools and/or individuals interested in exchanging programs which they developed. Write: Earl R. Savage, Craig County Public Schools, P.O. Box 245, New Castle, Virginia, 24127.

A Beautiful Way To Interface

IQ 140

SOROC's first and foremost concern, to design outstanding remote video displays, has resulted in the development of the IQ 140. This unit reflects exquisite appearance and performance capabilities unequaled by others on the market.

With the IQ 140, the operator is given full command over data being processed by means of a wide variety of edit, video, and mode control keys, etc.

The detachable keyboard, with its complement of 117 keys, is logically arranged into 6 sections plus main keyboard to aid in the overall convenience of operation. For example, a group of 8 keys for cursor control / 14 keys accommodate numeric entry / 16 special function keys allow access to 32 pre-programmed commands / 8 keys make up the extensive edit and clear section / 8 keys for video set up and mode control / and 8 keys control message and print.

Two Polling options available: 1) Polling compatible with Lear Siegler's ADM-2. 2) Polling discipline compatible with Burroughs.

IQ 120

The SOROC IQ 120 is the result of an industry-wide demand for a capable remote video display terminal which provides a multiple of features at a low affordable price. The IQ 120 terminal is a simple self-contained, operator / computer unit.

The IQ 120 offers such features as: 1920 character screen memory, lower case, RS232C extension, switch selectable transmission rates from 75 to 19,200 bps, cursor control, addressable cursor, erase functions and protect mode. Expansion options presently available are: block mode and hard copy capability with printer interface. The IQ 120 terminal incorporates a 12-inch, CRT formatted to display 24 lines with 80 characters per line.

SOROC TECHNOLOGY, INC.

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(714) 992-2860 / (800) 854-0147

CIRCLE 163 ON READER SERVICE CARD

Input/Output

Another BASIC Trick

Dear Editor:

Concerning the article in your September issue entitled, "BASIC Tricks" by Jordan Mechner, I was somewhat confused by the proposed methods of handling the STEP clause. I find the following method (on the right) to be clearer and more general in nature:

```
FOR V = A TO B STEP S
.
.
.
NEXT V

FOR U = 1 TO INT( (B-A)/S)+1
V = A + (U-1)* S
.
.
NEXT U
```

Note that this works equally well if A<B and S>0 or A>B and S<0.

William Wurzbach
1429 Windmar Dr.
Neenah, WI 54956

Personal Experience?

Dear Editor:

I could be wrong but the secretary referenced in "Can Computers Think - Part 2" by Peter Kugel (September 1979, page 107) was actually Weizenbaum's secretary. He describes her in his book, "Computer Power and Human Reason."

What surprises me is that Kugel and Weizenbaum take the same point of view; the secretary took a mechanical program seriously. It seems to me that the secretary was taking seriously the request by Weizenbaum to try out the program as if it was a real doctor. The best test is to speak in the realities of your own experience, which the secretary did; of course it got personal. The test, however, did not involve what was said, but how close the conversation came to the secretary's perception of reality. (In Eliza's case, not very close.) After the test she could describe her experience, not in terms of what she said, which was personal, but in terms of how well the computer did.

C. Terrance Ireland
George Washington University
Washington, DC 2006

Apple Hi Res Characters

Dear Editor:

I enjoyed the article in November **Creative Computing** concerning user-definable character generators. I think you made a serious omission, however, by not reviewing the high-resolution character generator written by Christopher Espinosa. This program is part of the Apple Software Bank (Bank Number: 00405), and is available from any Apple dealer, I believe for free.

The documentation for this program, contained in the publication **Apple Software Bank Contributed Programs Volumes 3-5** (Bonus Issue) (Apple Product #A2L0014), also includes full instructions on how to define your own characters and save them in the character table. Although the documentation describes use of the program in a 32K machine, I've used it in 16K and it works fine.

Scott Steketee
4639 Spruce St.
Philadelphia, Pa. 19139

The Apple Software Bank character generator program is not quite as user-oriented as the other packages tested, because it uses POKE statements for control of functions such as upper/lower case, rather than embedded control characters. Nevertheless it is a nice package and, as Mr. Steketee mentions, a best buy [because it's free]. SN

The Turing Test

Dear Editor:

Peter Kugel did not describe Turing's test or Turing's machine correctly in his article "Can Computers Think", (CC, Sept. 79). He also fails to credit Turing for suggesting computers be programmed to learn.

Briefly stated, Turing's test consists of two experiments. In the first experiment, a man, a woman, and an interrogator of either sex are placed in separate rooms. The interrogator tries to determine who occupies each room by asking questions. The man tries to make the interogator come to the wrong conclusion and the woman tries to help the interrogator make the correct identification. In the second experiment, a computer takes the place of the man and tries to mislead the interrogator. The results of the two experiments are compared to see if the computer can deceive the interrogator as often as a man. I would like to think Turing had a keen sense of humor and devised his test to encourage development of computers which lie. Indeed, the ability to lie well is a good indication of intelligence.

The machine Turing defined for his test is a digital computer, a discrete-state machine, and considered only to approximate the function of an analog machine. The "universal" machine can only duplicate the workings of all other discrete-state machines.

Turing suggested we try to make computers which can learn. Equip them with sense organs, teach them English, and allow them to learn by interacting with the environment as though they were children.

A reprint of Turing's 1959 paper on Computing Machines and Intelligence is in "Computers and Thought", edited by Feignbaum and Feldman, McGraw Hill, 1963 (still in print). This is light reading but leads to heavy thinking. The imitation game (Turing's test), a definition of his machine, and many different views and objections to intelligent machines are covered. Those interested in these subjects must read this classic.

Gerald Cahill
2550-90 East Ave I
Lancaster, CA 93534

Turing's original 1950 article which appeared in **MIND** *Magazine is reprinted in this issue starting on page* 44. *It is light reading but leads to heavy thinking.* —*DHA*

I've finally found a personal computer I respect. Compucolor II.

It's not surprising that professionals get excited about the Compucolor II. It's a totally-integrated 8080A system with full color graphics display, built-in 51K mini-disk drive, and the best cost performance ratio available in a personal computer.

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Unretouched photo of screen

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CIRCLE 161 ON READER SERVICE CARD

I/O, con't...

From An "Interpreter Author"

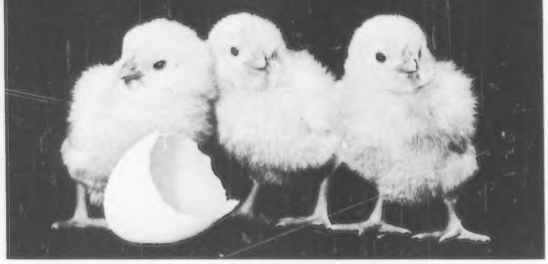
Dear Editor:

Your "Tiny Interpreter Excercise" by Philip Tubb in the September 1979 issue was of interest to me since I am an author of an interpreter. Although I don't view programming with the same strength of emotion Mr. Tubb exhibits, I disagree with several points in his article.

1. It is poor to store variable names in a separate table because names that are no longer in use build up. Series with simple typing errors will cause the symbol table to grow and grow.
2. HP Basic's interpretation of A$ (2) as a substring reference was rejected by ANSI. Microsoft BASIC-80, like any ANSI Basic, supports string arrays and treats A$ (2) as an array reference.
3. The surprise that Mr. Tubb expressed at not being able to input commas in unquoted strings is confusing since this is an ANSI requirement and not shameful as Mr. Tubb suggests. Comma is used to delimit multiple input items. LINE INPUT is provided in Extended Basic for exact literal input. A RENUM command is also provided.
4. HP's Basic, like ANSI, supports only one character per name. Applesoft extends this to 2 significant characters and Extended Basic to 40.
5. Microsoft's 5.0 Basic-80 is an ANSI compatible Basic. In fact, it is the only ANSI compatible Basic currently available for microcomputers.

Bill Gates, President
Microsoft
10800 NE Eighth, Suite 819
Bellevue, WA 98004

We've hatched a nestful of new tiny-c products.



Now you can really expand your horizons with the tiny-c structured programming language. The tiny-c owner's manual (including 8080 and PDP-11 source code and tiny-c in C) is still just $40. And we've added these new formats to really egg you on: TRS-80 Level II SYSTEM Format Cassette; CP/M Diskettes with 8080 Source; PDP-11 Diskette; North Star 5" Diskette; KIM and SYM cassettes. And there's more, plus lots to come. Order your tiny-c owner's manual today and get the whole story. Call or write: tiny c associates, P.O. Box 269, Holmdel, N.J. 07733. (201) 671-2296.
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tiny C

New Jersey residents include 5% sales tax. Visa and MasterCharge accepted. Include charge plate number with order.

Is It FORTH, or muSimp?

Dear Editor:

Hey, Waitaminute! I'll bet a dollar to a donut that muMATH-78/79 (July, '79) is good 'ol FORTH with some extended math functions and a handful of new words defined. I sat down at my PET, loaded up Programma's 6502 FORTH (not a very good FORTH, I may add), and proceeded to write muMATH 79 myself. But 6502 FORTH can't handle the extended math without some machine language words being defined (this is fairly easy to do in FORTH, but I quit at that point).

In FORTH, a word is defined by using words that were previously defined, which can then be used in the definition of more words, and so on *ad infinitum*..., which seems to be what was done here. Even the description of the "Package" on pp84-85 sounds like it came right out of the FORTH operator's manual. The way you "assign" words (WOW?) is pure FORTH. Executing words: pure FORTH. Even the format of print out/display is FORTH.

Perhaps $165 for an extended FORTH is worth the price (or perhaps not), but they shouldn't try to pass it off as a new language. Actually, I think FORTH should be renamed GOSUB!(this is an in-joke to FORTH users).

If this is the way computer languages are written/designed/created, I think I'll write a couple of Hyberbolic functions in BASIC, add them to Microsoft's Basic, and call the whole "Package" DMC: A NEW HIGHER MATH SYSTEM!

muMath indeed! muForth is more like it.

David M. Conley
10571 Kerigan Ct
Santee, CA 92071

Subject: Response to the letter by David Conley re: muMATH as FORTH

muMATH is a radical departure from traditional scientific programming languages. In contrast to mere numerical evaluation of formulas, muMATH can simplify expressions containing variables which have not been assigned numerical values. In short, muMATH can do algebra rather than merely arithmetic. A careful rereading of the July and August articles should clarify the distinction.

It is true that muMATH and FORTH share with the earlier languages APL and LISP the interactive style of permitting incremental mixing of program definition with program execution. Beyond that, there is relatively little internal or external similarity between muMATH and FORTH. Even the colon operator you mention is used differently in the two languages. muMATH is implemented in a language called muSIMP, which is internally similar to LISP but externally more similar to Pascal. Thus, I am afraid that you lose your bet of a "dollar to a donut."

It is of course possible to implement a symbolic math system in FORTH or any other general-purpose programming language; but you seriously underestimate the difficulty of this task, whatever language is used: The most powerful systems occupy between 1 and 2 megabytes of memory, and all of the serious systems have taken many person-years to develop by experienced experts in the field, with consequent costs which often exceed a million dollars. [The correct muMATH-79 license fee is, by the way, $190, which includes documentation that is separately available for $15.]

Perhaps the easiest way to appreciate the magnitude of the task and the dramatic difference from traditional scientific computation is to order the documentation, which includes reference manuals and lessons. You will find that muMATH now has a matrix package, a nonlinear equation package, and other powerful new capabilities beyond those described in the articles.

David R. Stoutemyer
General Partner
The Soft Warehouse
P.O. Box 11174
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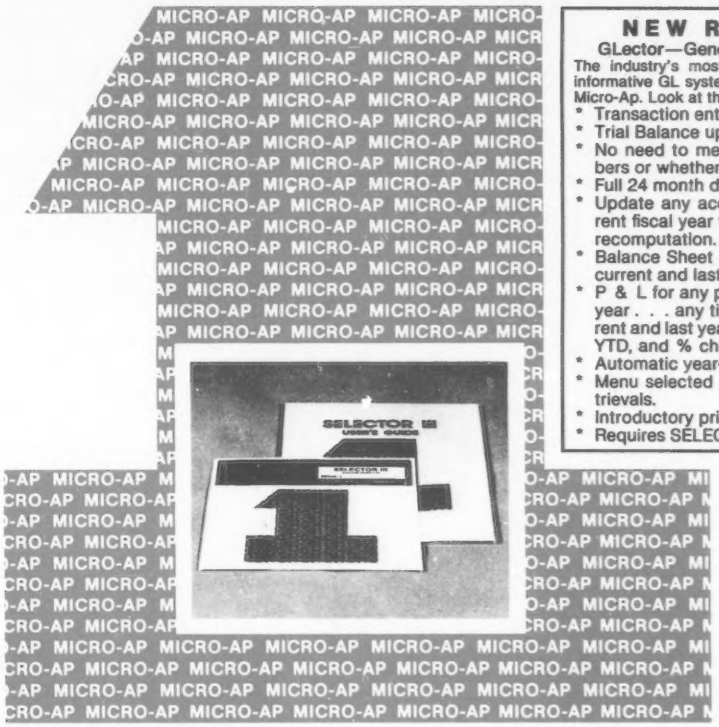

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The system represents the state of the art using Micro-Ap's unique record indexing, query, and report writing methods. It's 'menu driven' and uses screen displays with all the instructions and error sensing that allow the novice to quickly learn the system and accomplish his tasks.

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The system runs under CBASIC Vers. 2, and is priced at $345. It's available in a variety of CP/M, disk formats including Dynabyte; North Star; Micropolis; TRS-80; Helios II; Heathkit; iCOM; Altair; Imsai; Cromemco; and others.

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CIRCLE 171 ON READER SERVICE CARD

Effective Writing

David H. Ahl

Numbers Are Words Too

Yes, I know when I first threatened to run an effective writing column, I promised you a well-known lexicologist. Unfortunately, the person I had in mind got a better offer, namely a year sabbatical in Europe. Edwin Newman and William Safire were both committed, so it looks like you're stuck with me until someone more qualified volunteers. Two letter writers, in response to my short piece in September, pointed out that I had no business telling other people how to write and several others warned of the dangers in finding fault with the language of others. I agree that there are risks, but I disagree that there is no value to this sort of thing in the long run. A reminder about a rule of grammar or usage that might have been forgotten from school or perhaps never encountered previously may make the difference between a mediocre article (or report, letter, etc.) and one that stands out. I believe, as Donald Knuth believes about programming, that attention to many little details contributes far more to success than the initial idea.

Since numbers tend to crop up in articles about computing more than elsewhere, this first column is devoted to the proper (and improper) use of numbers in writing.

As a mentioned in my previous piece, to facilitate the reading of numbers of more than four digits, a comma is generally placed before each third numeral. The comma is usually omitted from numbers of only four digits such as 1000 or 9999 unless the number appears in a column having numbers that do require commas. For example, 32,876 or 5,127,467,000.

While "standard" book and magazine rules generally specify that all numbers in text should be written out, the same does not apply in technical writing. The general rule is that numbers nine and lower should be written out, but figures used for numbers 10 and higher. Several exceptions are noted below which require the use of figures for any number.

A unit of measurement, for example, always takes a figure (3 in., 5 lb, 8 v, or 15 amp). Figures are also used after terms of specific designation such as Socket 6, Order No. 4, Section 5 or page 6. Note that common nouns are capitalized when they are used with a number or letter to designate a specific thing. "Page," for reasons unknown to me, is an exception to this rule. Perhaps it is because there are so many of them.

Figures are also used for items in a series, such as 6 resistors, 4 capacitors, 17 IC's, and 1 mounting board. Plurals, incidentally, are formed using an apostrophe when the plural is to be made of a figure, letter, sign, symbol, hieroglyph or other character. Examples: 0's, K's, &'s, s's, ()'s and 80's. This last one was the subject of some debate in Safire's October 21 column in the *Times*. Said Safire, "An apostrophe — from the Greek word meaning 'turn away' — is a mark inserted when you turn away from using a letter. Or it is used to form the plural of numbers and letters. It does not always imply possessive." So although some editors claim that 80's implies something possessed by the decade of the eighties, this is just not the case. While we're on decades, shouldn't it be '80's as in the "spirit of '76?" No. The apostrophe goes only before a single year, not a decade. So, goodbye 70's and hello '80.

Figures are also used for dates and times as in 4:30 p.m. February 1, 1980. Use figures for sums of money; note the several acceptable ways of expressing amounts less than one dollar ($2400, $342.67, $3.49, $0.39, 39 cents, 39¢, 39c). Addresses use figures also (51 Dumont Place, Apt. 7C). Use figures to indicate a percentage as 4 percent, 4 per cent or 4%. Figures are also used in decimal numbers with a zero, if required, before the decimal point as 2.5 million, 12.4 volts, or 0.87 ft.

The use of figures in fractions is sometimes tricky. The rule is that figures should be used for fractions that appear with a whole number but they should be written out when they appear alone. Use a hyphen only if the word "of" does not follow the fraction. Examples: an increase of 5½ volts, an increase of one half of a pound, an increase of one-half pound, or two-thirds completed.

Hyphens can be bothersome little animals. They are generally used in both cardinal and ordinal numbers between twenty-one and ninety-nine (or twenty-first and ninety-ninth) but not for numbers such as one hundred or two thousandth. Hyphens are also used to form an adjective from a number and unit of measurement such as a 50-ohm resistance or 2-ton load, but not in a resistance of 50 ohms.

Write out numbers that come at the beginning of a sentence. If possible, it is better to recast the sentence so that the number is not at the beginning. "The circuit requires 35 IC's" is preferred to "Thirty-five IC's are required by the circuit." When numbers designating two different things come together one should be written out and the other designated by figures. Either of the following is acceptable: 20 fifty-volt capacitors or twenty 50-v capacitors.

A particularly confusing pair of abbreviations are those used for one thousand, namely K and M. In business and industry, especially electronics, K means 1000, as in 8K memory or a salary of $14K. However, in the printing industry, M is commonly used to represent 1000, as in a press run of 82M. This obviously stems from the Roman numeral usage of M to represent 1000. However, for 1000, we strongly prefer K. When used in **Creative Computing,** M will refer to one million, as in disk storage of 1.2M. Both letters, by the by, when used as abbreviations, should be capitalized, i.e., K and M, not k and m.

Should there be enough sentiment to continue this column, from readers that is, next time we'll delve into plurals (like data and S100's) and possessives (like the computer's memory versus the memory of the computer). □

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- (L) (M) **FORTRAN-80** — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) ..... **$400/$25**
- (L) (M) **COBOL-80** — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM, interactive ACCEPT/DISPLAY, COPY, EXTEND ..... **$625/$25**
- (L) (M) **MACRO-80** — 8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included ..... **$149/$15**
- (L) **XMACRO86** — 8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available. ..... **$275/$25**
- (L) **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included **$89/$15**

MICRO FOCUS

- (L) **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal ..... **$850/$50**
- (L) **FORMS 2** — CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by CIS COBOL (standard) ..... **$200/$20**

EIDOS SYSTEMS

- (L) **KISS** — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80, etc. ..... **$335/$23**
- (L) **KBASIC** — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS.REL as described above, and a sample mail list program ..... **$585/$45**
  to licensed users of Microsoft BASIC-80 (MBASIC) ..... **$435/$45**

All Micropro prices are discounted!

MICROPRO

Software with Manual / Manual Alone

- (L) **SUPER-SORT I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! ..... **$225/$25**
- (L) **SUPER-SORT II** — Above available as absolute program only ..... **$175/$25**
- (L) **SUPER-SORT III** — As II without SELECT/EXCLUDE ..... **$125/$25**
- (L) **WORD-STAR** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, read write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning **$445/$25**
- (L) **WORD-MASTER** Text Editor — In one mode has superset of CP/M's ED commands including global searching and replacing, forward and backwards in file in video mode, provides full screen editor for users with serial addressable-cursor terminal ..... **$125/$25**

SOFTWARE SYSTEMS

- (L) (M) **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables, etc. ..... **$109/$15**
- (L) **PASCAL/Z** — Z-80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, companion macro-assembler and source for the library. Requires 56K and Z-80 CPU.
  Version 2 includes all of Jensen/Wirth except variant records. ..... **$275/$25**
  Version 3 Upgrade with variant records and strings expected 2/80. ..... **$395/$25**
- (L) (M) **PASCAL/MT** — Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures and BCD arithmetic for real variables. CP/M file I/O and assembly language interface supported. Lacks Sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Requires 32K ..... **$95/$30**
  Source for PASCAL/MT run time package. Requires MAC. (See under Digital Research.) **$50**

Structured Systems prices are discounted!

STRUCTURED SYSTEMS GROUP

- (L) **GENERAL LEDGER** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness, etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. All reports can be tailored as necessary. Requires CBASIC-2 ..... **$859/$25**
- (L) **ACCOUNTS RECEIVABLE** — Open item system with output for internal reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC-2 ..... **$699/$25**
- (L) **ACCOUNTS PAYABLE** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC-2 **$699/$25**
- (L) **ANALYST** — Customized data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, search, and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level break-points for summarization. Requires CBASIC-2, 24 x 8 CRT, printer and 48K system. ..... **$225/$15**
- (L) **LETTERIGHT** — Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 ..... **$179/$25**
- (L) **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 ..... **$79/$20**
- (L) **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. ..... **$95/$20**

Graham-Dorian prices are discounted!

GRAHAM-DORIAN SOFTWARE SYSTEMS

Software with Manual / Manual Alone

- (L) (M) **GENERAL LEDGER** — An on-line system; no batching is required. Entries to other GRAHAM-DORIAN accounting packages are automatically posted. User establishes customized C.O.A. Provides transaction register, record of journal entries, trial balances and monthly closings. Keeps 14 months history and provides comparison of current year with previous year. Requires CBASIC-2. Supplied in source ..... **$495/$35**
- (L) (M) **ACCOUNTS PAYABLE** — Maintains vendor list and check register. Performs cash flow analysis. Flexible — writes checks to specific vendor for certain invoices or can make partial payments. Automatically posts to GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. ..... **$495/$35**
- (L) (M) **ACCOUNTS RECEIVABLE** — Creates trial balance reports, prepares statements, ages accounts and records invoices. Provides complete information describing customer payment activity. Receipts can be posted to different ledger accounts. Entries automatically update GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. ..... **$495/$35**
- (L) (M) **PAYROLL SYSTEM** — Maintains employee master file. Computes payroll withholding for FICA, Federal and State taxes. Prints payroll register, checks, quarterly reports and W-2 forms. Can generate ad hoc reports and employee form letters with mail labels. Requires CBASIC. Supplied in source code. ..... **$495/$35**
- (L) (M) **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC. Supplied in source code. ..... **$495/$35**
- (L) (M) **JOB COSTING** — Designed for general contractors. To be used interactively with other GRAHAM-DORIAN accounting packages for tracking and analysing expenses. User establishes customized cost categories and job phases. Permits comparison of actual versus estimated costs. Automatically updates GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. ..... **$495/$35**
- (L) (M) **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC. Supplied in source code. ..... **$495/$35**
- (L) (M) **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales, overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source code ..... **$495/$35**

- (M) **tiny C** — Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings ..... **$75/$40**
- (L) (M) **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie ..... **$110/$15**
- (L) **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX*** Version 7 C language. Designed by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M ..... **$630/$30**
- (M) **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual. ..... **$135/$15**
- (M) **POLYTEXT/80** — Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Support for Daisy Wheel printers includes variable pitch justification and motion optimization. ..... **$85/$15**
- (L) **ALGOL-60** — Powerful block-structured language compiler featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling and disk address I/O etc. Requires Z80 CPU ... **$199/$20**

Prices and specifications subject to change without notice.

Z80 DEVELOPMENT PACKAGE

Software with Manual / Manual Alone

- (M) **Z80 DEVELOPMENT PACKAGE** — Consists of: (1) disk file line editor, with global inter and intra-line facilities, (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities, (3) linking loader producing absolute Intel hex disk file. ..... **$95/$20**
- (L) **ZDT** — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package ..... **$50/$10**
- (L) **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080. ..... **$65/$10**
- (M) **DISLOG** — As DISTEL to Zilog Mostek mnemonic files. Runs on Z80 only ..... **$65/$10**
- (L) **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments in other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. ..... **$125/$20**
- (M) **POSTMASTER** — A comprehensive package for mail list maintenance. Features include keyed record extraction and label production. A form letter program is included which provides mail letters with single sheet or continuous forms. Requires CBASIC-2 ..... **$150/$25**
- (L) **WHATSIT?**** Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 ..... **$125/$25**
- (L) **XYBASIC** Interactive Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions.
  Integer Disk or Integer ROMable ..... **$295/$25**
  Extended Disk or Extended ROMable ..... **$395/$25**
- (L) **SMAL/80** Structured Macro Assembled Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs ..... **$75/$15**
- (M) **SELECTOR III-C2** — Data Base Processor to create and maintain multi Key data bases. Prints formatted, sorted reports with numerical summaries or mailing labels. Comes with sample applications including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC Version 2. Supplied in source code **$295/$20**
- (L) **CPM/374X** — Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files ..... **$125/$20**
- (L) **BASIC UTILITY DISK** — Consists of: (1) CRUNCH-14 – Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN – Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation ..... **$50/$35**
- (L) **THE STRING BIT** — Fortran character string handling Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source ..... **$45/$15**
- (M) **BSTAM** — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it to "phone home" from Lifeboat's expansys to send * .COM files at 300 baud with verb. 300 baud with phone connection. Both ends need one. Standard and M versions can talk to one another. Compatible TRSDOS version also available ..... **$150/$35**
- (L) **Flippy Disk Kit** — Template and instructions to modify single sided 5¼" diskettes for use of second side in single sided drives **$12.50**
- (L) **FLOPPY SAVER** Protection for center holes of 5¼" floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool, 1 quart 7-mil mylar reinforcing rings. Installation tool and rings for 25 diskettes. **$14.95**
  Re-orders of rings only **$7.95**

*CP/M is a trademark of Digital Research
**Z80 is a trademark of Zilog, Inc
***UNIX is a trademark of Bell Laboratories
****WHATSIT? is a trademark of Computer Headware

†CP/M for Heath, TRS-80 Model I and PolyMorphic 8813 are modified and must use specially compiled versions of system and applications software.

(M) Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers

(L) User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made

Shopping List No.8

Software for most popular 8080/Z80 computer disk systems including
NORTH STAR, iCOM, MICROPOLIS, DYNABYTE DB8/2 & DB8/4, EXIDY SORCERER, SD SYSTEMS, ALTAIR, VECTOR MZ, MECCA, 8" IBM, HEATH H17 & H89, HELIOS, IMSAI VDP42 & 44, REX, NYLAC, INTERTEC, VISTA V80 and V200, TRS-80 MODEL I and MODEL II, ALTOS, OHIO SCIENTIFIC and IMS 5000 formats.

Orders must specify disk systems and formats: e.g. North Star single, double or quad density, IBM single or 2D/256, Altair, Helios II, Micropolis Mod I or II, 5¼" soft sector (Micro iCOM/SD Systems Dynabyte), etc.

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

The sale of each propriety software package conveys a license for use on one system only.

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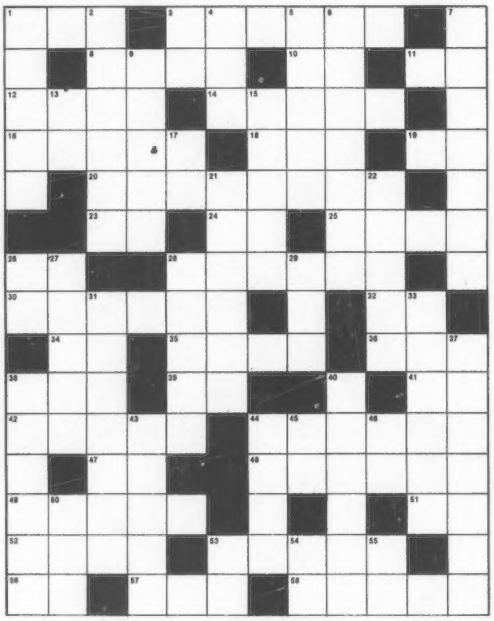


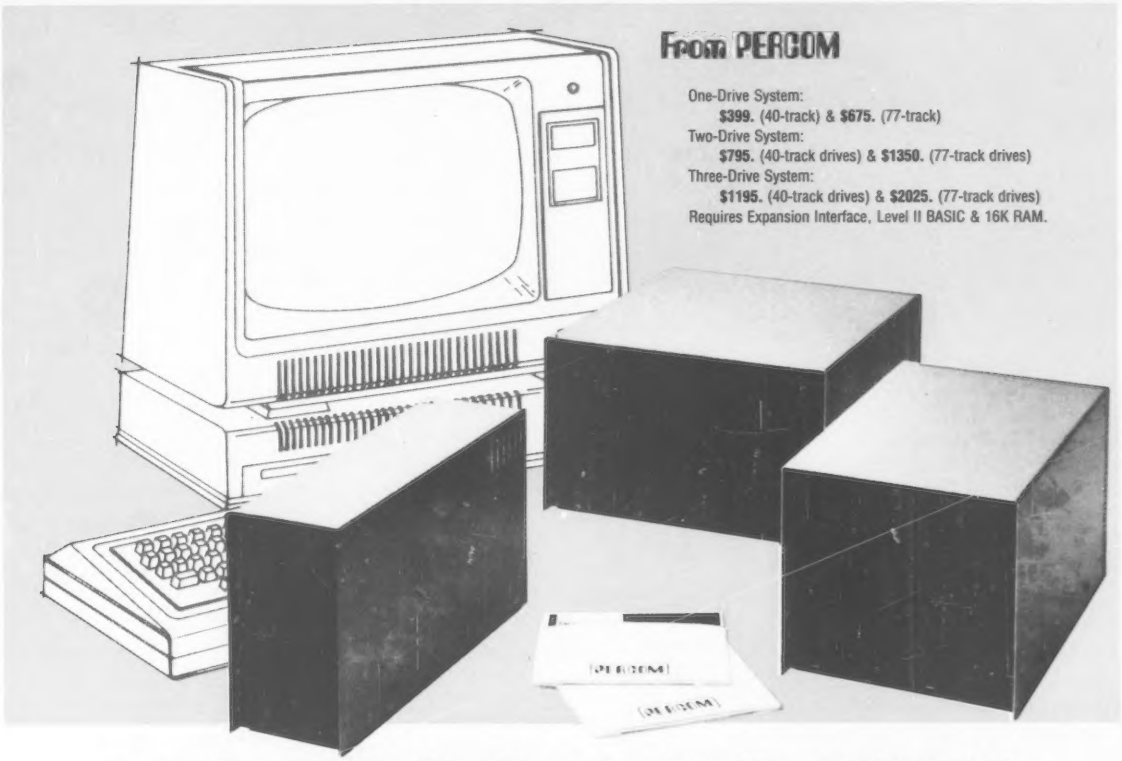
ACROSS

1. Ah, that's the
3. Type of print mechanism
8. Verdi opera
10. Exclamation of satisfaction
11. Inductivity
12. Computer is modern counterpart of this Norse goddess
14. 0l Informatique published here
16. Gold Book
18. This mythical bird could carry a midi computer
19. Functioning
20. CRT and illness
23. Former
24. Kind of electrical current
25. Religious teacher
26. Tesla invented it
28. Phaser, photo torpedo
30. Memory bubbles travel in one
32. Type of radio transmission
34. Doctor of engineering
35. Sometimes causes blackouts
36. Steal
38. You can't have too much of this (abbrev.)
39. Parasitic's power supply compared to Altair
41. Egyptian sun god
42. That which goes in
44. Means of ascent
47. Cheery greeting
48. Major communications systems manufacturer
49. Scottish explorer
51. Ida Tarbell's target
52. Most video monitors made there (second word)
53. Altairs have one for programmers
56. Railroad
57. His relative pops out of a clock
58. Type of power outage

DOWN

1. -32,767 to 32,767
2. Mineral used in paint
3. You need one to enter DOD computer installations
4. Memory —
5. Moses' older brother
6. Summer Consumer Electronics Show held here
7. Jumps technology will make
9. Type of register
13. Ohio University
15. Department of northern Chile
17. Forms the comparative degree of adjectives
21. What a nice girl becomes when reading a sexist article
22. Popular computer game lands you on this surface
26. It pays a company to put one in Creative Computing
27. Code classification assigned to book or magazine
28. Human being
29. Homophone of 3.14159
31. Ancient city in Egypt
33. County where Creative Computing is located
37. Difficult to simulate this woodwind instrument on a computer
38. Moth with powdery wings
40. A lifetime in computers
43. Mountain range in Utah
44. Tree yielding a thick, white fat
45. Transactional Analysis
46. Infrared
50. River in Switzerland
53. Approx. 22/7
54. Canadian province
55. And behold!

John K. Young, 167 Richard Road, Braintree, MA, 02185



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To order add-on mini-disk storage for your TRS-80*, or request additional literature, call Percom's toll-free number: 1-800-527-1592. For detailed Technical information call (214) 272-3421.

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It is the personal computing service of CompuServe, Incorporated. CompuServe is a nationwide commercial time sharing computer network with large-scale mainframes. MicroNET allows the personal computer user access to CompuServe's large computers, software and disc storage during off-peak hours (from 6 PM to 5 AM weekdays, all day on Saturdays, Sundays and most holidays).

What do I get?

You can use our powerful processors with X-Basic, Fortran, Pascal, Macro-10, AID or APL. You get 128K bytes of storage free (just access it at least once a month). Software includes games—including networking multi-player games—personal, business and educational programs.

In addition, there is the MicroNET National Bulletin Board for community affairs, for sale and wanted notices and the MicroNET Electronic Mail System for personal messages to other MicroNET users. You can even sell software via MicroNET.

NEW! MicroQUOTE, a security information system for corporate stocks and public debt.

NEW! MicroNET Software Exchange with dozens of new programs available for downloading to your personal computer at a specified charge.

NEW! Executive programs for TRS-80, Apple II and CP/M systems (so your machine and ours can talk to each other error-free). You can switch between terminal and local mode while on line.

What do I have to have to use MicroNET?

The standard 300 baud modem. MicroNET has local phone service in most major cities (see below) and a reduced phone charge in over a hundred others.

What is the cost?

We've saved the best for last. There is a one-time hook-up charge of only $9.00! Operating time—billed in minutes to your VISA or MasterCharge card—is only $5.00 an hour.

Want more information?

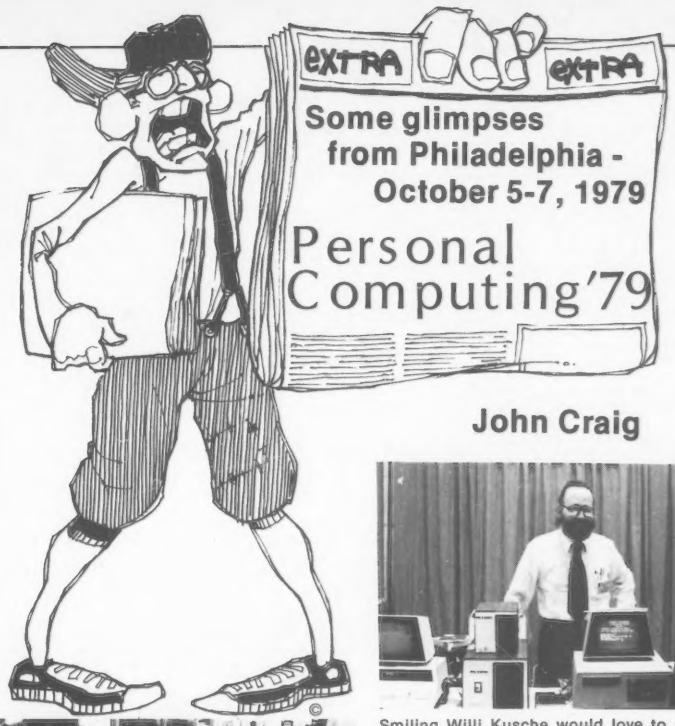
Good. Write to us at the address below. We'll send you a full packet of information about MicroNET.

CompuServe
Personal Computing Division
Dept. C
5000 Arlington Centre Blvd.
Columbus, Ohio 43220

MicroNET is available via local phone calls in the following cities: Akron, Atlanta, Boston, Canton, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Dayton, Denver, Detroit, Houston, Indianapolis, Los Angeles, Louisville, Memphis, West Caldwell (NJ), New York, Philadelphia, Pittsburgh, San Francisco, Stamford (CT), St. Louis, Toledo, Tucson and Washington, D.C.

Access to the MicroNET service is available in 153 other cities for an additional charge of $4.00 per hour.

"... but the really impressive stuff is in the back room."



Some glimpses from Philadelphia - October 5-7, 1979

Personal Computing'79

John Craig

Alan Hald and Jeff McKeever (in the rear), are President & Chairman of the Board of MicroAge. They're sitting in the middle of a popular demonstration/display, "Albert the Office." The system, based around a North-Star Horizon, has many "bells & whistles" such as the computer controlling the coffee pot, TV, thermostat, lights and so on... many by interpreting speech commands. I suspect that many of these capabilities are, for the moment, serving as attention-getters aimed toward potential small business customers. MicroAge has a similar system, called "Fred The House," which is being demonstrated in computer stores around the country. MicroAge, 1425 KW. 12th Pl., Tempe, AZ 85281.

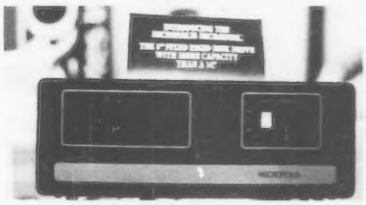
Xymec (17791 Skypark Circle, Suite H, Irvine, CA 92714) has developed a daisy-wheel printer that has many extraordinary capabilities. The features of the Hy-Q 1000 are so numerous and impressive, that I wouldn't dare try to describe them in a photo caption. You'll be seeing a full-blown review of this $2495 beauty in the near future.

Smiling Willi Kusche would love to sell you 6502 owners a good disk operating system for your PET, KIM, SYM and AIM systems. You'll have the advantage of inter-system compatability (between those mentioned) because of the soft-sectored format used - an advantage over Commodore's system. Wilserv Industries, PO Box 115, Haddonfield, NJ 08033.

Roland Joffe is demonstrating an impressive multi-user education package he developed for the North Star Horizon. Micro Innovations, Inc., 420 Lexington Avenue, New York, NY 10017.

Would you like to have your TRS-80 talk... inexpensively? Percom has developed a small PC board which interfaces a TI Speak 'N Spell to a TRS-80 and it works very well. Drop them a line for more info: Percom Data Corporation, Inc., 211 N. Kirby, Grland, TX 75042.

Dr. Portia Isaacson, in the foreground, has led a team of specialists in the development of an impressive series of video tapes for computer stores and their customers. The tapes have been professionally produced, with the objective of helping to overcome the lack of basic knowledge and understanding found in many potential computer purchasers. Some of the tapes in this series include; "BASIC Training," "What Is The Bottom Line?" (should a small busines use a computer), "Apple Basic Training" and "What is Personal Computing?" Dr. Harold Kinne (on the right) and Bryan LeBlanc are also involved in the Evolution 1 series. Electronic Data Systems Corporation, 14580 Midway Road, Dallas, TX 75234.



One of the highlights of the show was Micropolis' unveiling of their new Model 1240 thirty megabyte hard disk for under $5500. That price includes their multi-user OSM operating system, controller and Z80 S-100 interface adaptor. Micropolis Corp., 7959 Deering Ave., Canoga Park, CA 91304.

It is not often that one has the opportunity to play with the console of an IBM 360. The obvious glee being displayed by this young woman indicates that she's probably one of the thousands of programmers who have only been able to **look** at the monster behind glass doors and windows. The 360 was part of a feature display of historical computing put on by PC '79.

CC's retail sales rep pushes t-shirts at PC. □

Apparat's latest entry appears the winner

NEWDOS vs. TRSDOS

Dick Fuller

Radio Shack has introduced a new disk operating system for the TRS-80. It is called TRSDOS 2.2. It costs former TRSDOS 2.1 owners nothing, it's free. NEWDOS, from Apparat, Inc., is a new disk operating system that costs almost $100. Why should anyone pay almost $100 for something they can get for free? As you might suspect, there is a catch. TRSDOS 2.2 and NEWDOS both work on the TRS-80 computer, but here the similarity ends. It would be much like comparing apples to oranges. We're going to be examining the features of both systems and the bottom line is that you should probably have both.

Almost any function of this DOS can be stopped or KILLed if that part is not desired.

We purchased our NEWDOS from Jerry Washburn of Microcomputer Technology, Inc. A phone call, and three days later we had the diskette in our hands. The first thing we did after opening the package was glance at the documentation to see what this new DOS does that makes it better than the TRSDOS 2.1. We found that it does so many new and great things that its sophistication and versatility couldn't be included in anything less than a full page ad! The $95 price is steep, but when you think about it, it costs that much to go from Level I to Level II. We think the step from TRSDOS 2.1 to NEWDOS is a similar step, and worth the price, if you find you need the additional power in NEWDOS.

Dick Fuller, Fuller Electronics, 7465 Hollister, Suite 232, Goleta, CA 93017.

Added BASIC Capabilities

Let's review the features of this new tool. BASIC is now much more powerful. A renumber program allows you to renumber, starting anywhere in the program, to anywhere in the program, by any increment.

The keyboard debounce routine is automatic, but can be disabled. As a matter of fact, almost any function of this DOS can be stopped or KILLed if that part is not desired. You can enter BASIC with one statement. While you are in DOS you type; BASIC 10,32000, RUN"SPECIAL/BAS." This will accomplish several things. It puts the user in BASIC, with a memory size of 32000, with 10 files, loads and runs the BASIC program of yours named "Special." Yes, Virginia, you can now run a BASIC program from power up!

Is there more? Yes, much more. Next is a command that anyone with a printer in his possession, or future, will praise. You now have a screen printer. By pressing the J, K and L keys simultaneously, whatever is on the video is duplicated on the printer. This feature works as well for RS-232 configurations as parallel.

With NEWDOS you can add to a closed sequential file.

All DOS commands such as DIR, FREE, CLOCK and TRACE can be called from BASIC without ever leaving BASIC. Have you ever left BASIC accidentally with a CMD"S" or a reset and lost your BASIC program? With NEWDOS there is no problem. From DOS simply type BASIC *. Not only are you back in BASIC with your old program, your memory size and file size are still the same as you were using.

"REF" gives you an ASCII list of all integers and letters used.

Abbreviations are back with NEWDOS. Those of us who were spoiled by the abbreviations included in LEVEL I BASIC, bemoaned the loss of them when it was replaced by LEVEL II. List, edit and delete can be used, but it's easier in NEWDOS to use L, E and D. If you type a period or comma before the single letter command and line number, you will list or edit the line pointed to by the period. Remember how hard it was to find the line you wanted as the LIST went scrolling by at Warp 3? Now you can single step as in LEVEL I. You can do this from the first line, the last line or the line pointed to by the period. Or, you can still use Warp 3, if you wish.

With NEWDOS you can add to a closed sequential file. TRSDOS 2.1 required that you start a new file, load the old one into it and continue on from there.

Ever write a program, get well into it, and wonder whether you have used "C" or "NI" as a variable yet? A command called "REF" gives you an ASCII list of all integers and letters used, and the line numbers where the variable or integer was used. It also tells you if it is a string variable and how many times it is used in that line.

Level one is also provided on disk. We tried LEVEL I on an old CLOAD magazine issue; it works, just like a LEVEL I computer. Another plus is that you can also store LEVEL I programs on disk. There are more, but those are the main BASIC enhancements.

Assembler and Disassembler

The assembler provided with NEWDOS is essentially the same as the standard Radio Shack assembler. It is, however, greatly improved. First and foremost, it is on disk. Some of us have managed to get Radio Shack's assembler on disk using DCV put out by the good people at Small System Software. One advantage from NEWDOS for RS-232 systems is that the old driver will work, in both the assembler and disassembler. The driver should be moved down from the top of memory far enough so that it and the source code you're working with don't overlap, and yet not so low as to interfere with the Editor/Assembler. When you assemble with a symbol table you get a bonus. All symbols are listed with the program lines each symbol appears in. The disassembler will disassemble a program, using Z-80 mnemonics, from either memory or disk. It supports the video or a printer. The disassembler will work with displaced programs (programs that are located in memory, but not in their normal position for running).

The old driver will work in both the assember and disassembler.

Summary

Radio Shack's TRSDOS 2.1 isn't perfect, and neither is NEWDOS. The first deficiency we noted with NEWDOS is the documentation. It was written using an assembler and a dot matrix printer. The result is that every line has a line number and a semicolon (we understand the line numbers have been eliminated from the newest copies of the documentation). It also means that after the original was copied, apparently using a copier, the symbols seemed to merge into a blob. The text appears to have been written as a reminder for the author of NEWDOS and not intended to teach the new user how to use NEWDOS. There are no examples showing how commands are used. The author uses many buzz words which makes it very hard to understand unless you are familiar with the terminology freely thrown around by professional programmers.

One deficiency we noted with NEWDOS is the documentation.

One of the reasons we decided to buy a TRS-80 was because we felt that there would be a lot of software and hardware available for the machine. This theory seems to have been elevated to an axiom. Many new, and very useful items are continually appearing on the market for the TRS-80. If one were to rank these in order of usefulness and value, NEWDOS would appear very high on the list. In our opinion, NEWDOS is worth every bit of its $95 price tag.

NEWDOS is a product of Apparat Inc., 6000 E. Evans Ave. #2, Denver, CO 80222. Their phone number is (303) 758-7275. NEWDOS is also sold by Microcomputer Technology Inc., 2098 South Grand Ave., Grand Centre, Santa Ana, CA 92705, (714) 979-9923.□

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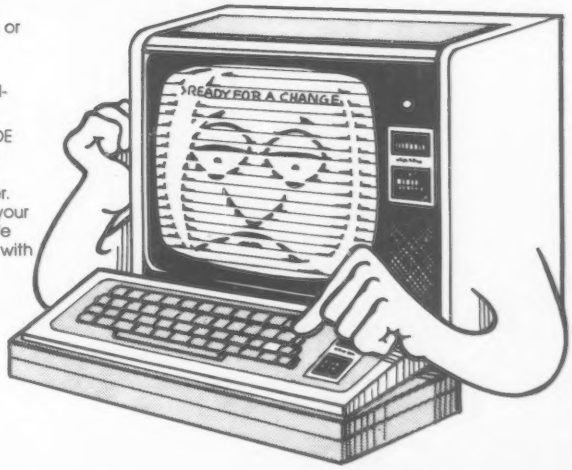

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With a host of new features

A New BASIC From Tarbell

Glenn A. Hart

There are now literally dozens of BASIC interpreters and compilers available for various microcomputers. While each has its faithful users and fanatic proponents, three main families of BASICs have emerged as leaders for the 8080/8085/Z-80 microprocessors.

Probably the most widely used are the various dialects of Microsoft BASIC, including Microsoft's own versions for cassette systems and CP/M disk systems and customized variations for the TRS-80, PET, Apple and Sorcerer. North Star BASIC, which is primarily limited to North Star-based disk systems, has gained wide usage through its early entry into the field and popularity and low cost of North Star systems. Finally, the CBASIC compiler/interpreter system has become increasingly popular due to its speed of execution, its high precision and use of intermediate files, which allows commercial software publishers to avoid distribution of source code.

Each main family of BASIC offers its own point of view on extensions to the original definitions of the language and has its own set of peculiarities. For example, Microsoft and North Star only recognize short variable names, which limits readability and can lead to confusion on variables used in long programs. CBASIC remedies this, but the compiler/interpreter structure lengthens software development time significantly. North Star's string handling procedures in early versions, did not allow variable length string arrays, which make writing certain types of programs difficult. Microsoft requires that all data, both numeric and string, be stored in disk files in string form, necessitating the use of cumbersome and artificial conventions which can make data files a real chore.

In spite of these and other difficulties, each BASIC family represents a stable, debugged, useable language. A tremendous number of programs have been published or offered by commercial software houses in each family. Do we need yet another, fundamentally different, BASIC variation?

Glenn A. Hart, 44 Bon Aire Circle, Suffern, NY, 10901

Parameter Passing and Other Hardball Programming Tools

Many microcomputerists cut their first programming teeth on BASIC, often on mainframe, mini or time sharing systems. To them, the enhancements offered by current microprocessor versions are so far above their first BASICs that little more could be desired.

Programmers who started using other high level languages may not be so enamored with even our sophisticated current BASICs. Where other languages allow alphanumeric labels for statements to improve readability and indicate the logical flow of a program, all microcomputer BASICs use line numbers, either on every line or for passing control from statement to statement.

More important, still, are the concepts of parameter passing and local and global variables. Most other high level languages allow variables to be defined only for use in a given subroutine without affecting variables in the main program, even if the variable names are the same. Such subroutine variables are designated **local** variables, as distinct from **global** variables which are common throughout the entire main program and subroutine when it is called. This parameter passing is an extremely important programming tool, and while it can sometimes be simulated in current BASICs, its lack is a major weakness in almost all BASICs.

Enter Don Tarbell

Don Tarbell, long famous for his reliable and low-cost cassette and floppy disk interfaces, has introduced a new BASIC which answers these problems and offers many interesting new approaches to other weaknesses of current BASICs. Written by Tom Dilatush of Real time Microsystems, Tarbell BASIC is available in both cassette and disk versions. This analysis is based on the CP/M Version 12.12 release dated June, 1979.

Tarbell BASIC is an interpreter requiring 24K of RAM. This is a lot of storage, and planned future enhancements will probably up this memory requirement still further. Tarbell also runs somewhat slower than some other BASICs on many programs, since it uses 10 digit BCD rather than 8 digit binary for improved accuracy. Long programs with many variables and branches may actually run faster due to Tarbell's internal procedures.

Tarbell uses four operating modes: Command or Direct Mode, for immediate entry and execution of most statements (calculator mode); Entry Mode, for creating or inserting program text; Edit Mode, with a complete line editing facility; and Run Mode, the normal, programmed execution mode.

Unlike all other microprocessor BASICs, Tarbell line descriptors can be either line numbers or any alphanumeric string of characters except spaces or punctuation. Thus, lines can be designated FINDAREA, TABLE /* TERMINATE or any other meaningful label. As in CBASIC, the only lines that require any line descriptor at all are those which are referred to by another program statement. In normal programming, only a very few statements receive descriptors, and the alphanumeric descriptors make the logical flow of the program much easier to discern.

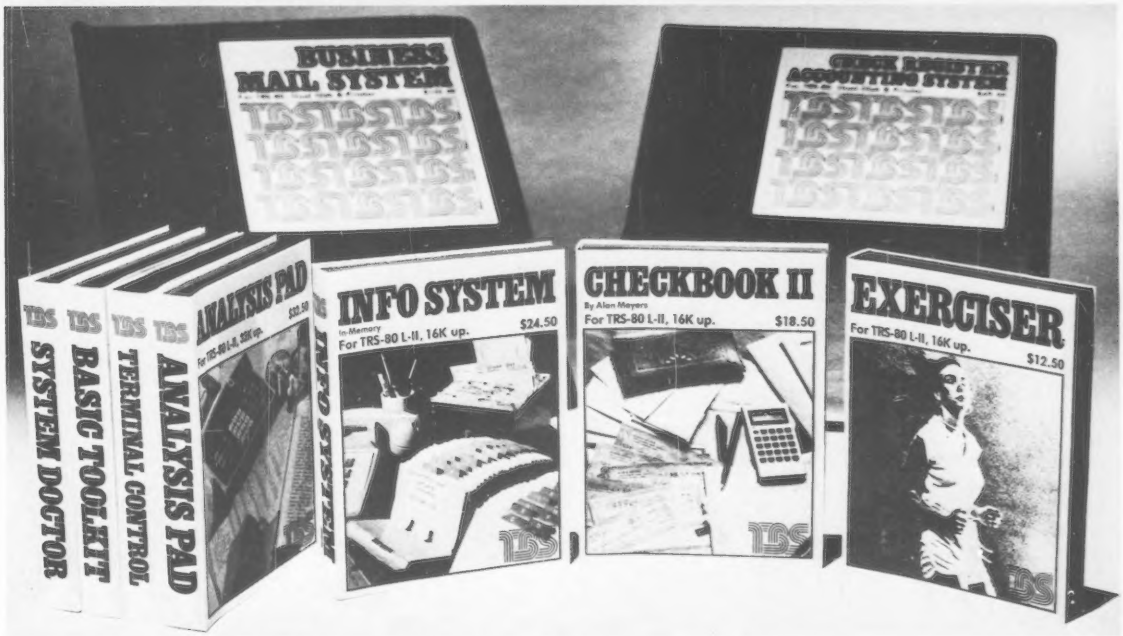
Variable names can also be as long as desired. HYPOTENUSE DAYOFMONTH, SORTROUTINE, etc., are all okay. Readability would be better if Tarbell allowed use of the period in names, e.g., DAY.OF.-MONTH.

New or Different Statements

APPEND adds a program segment from a disk file to the end of a program currently in memory. This is especially useful for inclusion of frequently used routines during the entry of new programs.

ASSIGN, CHANNEL and DROP control device input-output handling. This is an area where Tarbell BASIC really shines, offering probably the easiest and most flexible procedures of any current BASIC. Tarbell recognizes 8 logical devices, of which 6 are

THE BEST.



If you're not content with just playing games, **TBS** is producing applications software for your TRS-80 Level II that makes it a practical tool.

CHECKBOOK II by Alan Meyers is the finest program of its kind yet published. With superb graphic screen displays, it does everything necessary to keep your checkbook balanced. Data is input directly into a five-column screen display with a field for alpha or numeric codes. Editing is done easily in any or all columns. **CHECKBOOK II** will accurately balance and reconcile your checkbook, handling balances up to $1,000,000. Your balance brought forward is always in memory. Outstanding checks are listed and easily saved. You can also search for an entry by any field except amount, and all checks with matching entries will be displayed and totaled. A numeric sort routine is included. Screen prints can be made to a line printer from almost any point in the program. In addition, the 32-48K version can write files to disk. This and the 16K version are included on the same tape. For $18.50, **CHECKBOOK II** is the top of the line in personal checkbook programs.

INFORMATION SYSTEM by Dale Kubler is simply the best in-memory, data base manager on the market. It allows you to create files with up to ten categories per 'page', up to 40 characters per category and 200 characters total per page. Data from the keyboard is entered directly on a screen display of one entire page. Once entered, you can sort or search your entire data base by any category and have the information desired displayed on the screen. **INFORMATION SYSTEM** provides a thorough editing mode allowing changes by line without rewriting an entire file. Program your own printouts to almost any form you desire for line or serial printers. Screen prints from anywhere in the program are also available. **INFORMATION SYSTEM** creates either disk or cassette files depending on the version you use. Four versions are supplied with the program tape. From mail lists to recipes, for only $24.50, this program is the ideal information manager.

EXERCISER is for everyone. This program allows you to set your own physical fitness goals, then chart and analyze your progress toward these goals. Further, you may program an exercise regimen, then have the computer 'coach' you through your exercise routines. This system will allow you to use your computer to reinforce your effort to attain physical health. **EXERCISER** is really two programs in one. One measures your progress in jogging, swimming and bicycling and the other is for setting calisthenic regimens. It has long been known that to effectively structure an exercise program, it is necessary to think in terms of goals which can be met over a period of time. Whether you are training for the Boston Marathon or just wish for a minimum level of fitness, **EXERCISER** is designed to help you attain your goals. The price for this exceptional program is just $12.50.

TBS has other great software for your TRS-80. **BASIC TOOLKIT, SYSTEM DOCTOR & TERMINAL CONTROL** are systems utilities. **BUSINESS MAIL LIST, DATA BASE MANAGER, CHECK REGISTER ACCOUNTING SYSTEM & ANALYSIS PAD** are strong applications for business. Don't forget the **LIBRARY 100;** 100 programs for only $49.50. **TBS** also has **DISK HEAD CLEANERS** for **TRS-80** and **APPLE** and **GRAN MASTER DISKETTES,** the best on the market.

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New Basic, con't . . .

currently implemented (INPUT, PRINT, LOAD, SAVE, BGET/BLOAD, BPUT/BSAVE), and 10 physical devices (Console Keyboard, Console Printer, Cassette Input, Cassette Output, Spare Input/Output, Listing Device Output, Reader Input, Punch Output, Disk Input and Disk Output). Tarbell allows changing the correspondence between Logical and Physical devices much as STAT does in CP/M. CHANNEL shows the current assignments, ASSIGN and DROP change the settings. The default assignments can be changed by modifying the assembly language I/O routines provided with the interpreter.

BGET and BPUT handle transfers of binary stored data from and to binary data files, as GET and PUT are used for ASCII stored data files. Up to 64 data files can be open at one time and data handling is very easy, even in the random access mode. The procedures used are similar to those of CBASIC, rather than the complexity of Microsoft or North Star BASIC. The data file formats chosen are unfortunate, since they are not compatible with most external sort/merge programs, mailing list handlers and others.

CHECK makes a following mass storage input statement a checking operation instead of an actual read into memory. This is a useful doublecheck on data integrity, but its utility would be much greater if some form of ON ERROR GOTO error trapping mechanism were included.

GOPROC is similar to GOSUB excedpt it allows the subroutine to have local variables which are not affected by assignments outside the routine. As with Tarbell GOSUB's, variable values may be passed to the subroutine and received back from it with the RETURN and RECEIVE statements.

MOVEBOF and MOVEEOF move to the beginning or end, respectively, of a selected disk file before executing the next disk operation. This is useful in positioning pointers in sequential files; it doesn't apply to random access files.

PROCEDURE declares local variables which can be used in a subroutine without disturbing their original values in the main program. The next RETURN statement restores each variable's original value. The choice of "procedure" as the word for this operation is unfortunate, since it is not particularly descriptive (perhaps "LOCAL" would be better), has nothing to do with any actual procedural occurrence and is used in PASCAL, COBOL and other languages to mean something quite different.

RESET performs a disk operating system reset to reread the directory after changing a disk and before writing to the new one.

WIDTH sets the width of lines printed on various physical devices.

Functions

Most Tarbell BASIC functions operate in a manner similar to other BASICs. Here is a list of those which operate differently or are unique.

CALL and USER are both available for machine language subroutines. Function LOC returns the decimal memory address of a variable's value, which is useful for passing addresses to routines accessed by CALL.

EOF returns true (-1) if an end-of-file condition has been encountered during the last read operation, false (0) otherwise. Useful for end-of-file detection traps like IF EOF(1) THEN GOTO WRAPUP.

FILEXISTS checks if a program or data file exists. Example: IF FILEXISTS (PAYROLL.DAT) THEN GOTO PROCESSPAYROLL ELSE GOTO NOTFOUNDTRAP.

HEX,HEX$, OCT and OCT$ perform hexadecimal/decimal and tal/decimal conversions in either direction.

POS returns the current position of the print device. More useful than Microsoft's implementation, which can determine the position only of the console device, not the system printer.

RND starts a new sequence of random numbers with a negative argument, returns the same random number as the last RND used with a zero argument, and returns the next random number in the sequence with a positive argument. Useful for debugging programs using random numbers by allowing a repeatable sequence.

SEARCH searches the current disk file for the first or next occurence of a specified string. Returns the number of carriagae returns + 1 that it has passed while searching. Useful for indexing random files with sequential files.

Several "special functions" are included as well. These are interesting in that they merely set the value stored in certain memory locations. Since this value remains constant until changed again, these functions make disk handling easier by eliminating the need for restating disk parameters in repeated BASIC statements unless a change is necessary.

DISK specifies which drive to select from among the four that Tarbell BASIC can access. Defaults to the currently logged drive.

DO passes two numeric or string expressions to two specific memory

TABLE ONE

RESERVED WORDS BY TYPE

COMMANDS:	BYE	CHANGE	CONT	DELETE
	ENTER	LIST	NEW	RUN
	SYMBOL	EDIT		
STATEMENTS:	APPEND	ASSIGN	BGET	BLOAD
	BPUT	BSAVE	CHANNEL	CHECK
	CLEAR	CLOSE	DATA	DEF FN
	DIM	DIR	DROP	END
	ERASE	FOR	GET	GOPROC
	GOSUB	GOTO	IF-GOTO	IF-THEN-ELSE
	INPUT	LET	LOAD	MOVEBOF
	MOVEEOF	NEXT	ON-GOSUB	ON-GOTO
	OPEN	OUT	POKE	PRINT
	PRINT USING	PROCEDURE	PUT	READ
	RECEIVE	REM	RENAME	RESET
	RESTORE	RETURN	SAVE	SET
	STOP	WAIT	WIDTH	
FUNCTIONS:	ABS	ASC	ATN	CALL
	CHR$	COS	EOF	EXP
	FILEXISTS	FILL$	FRE	HEX
	HEX$	INP	INT	LEFT$
	LEN	LOC	LOG	MATCH
	MID$	OCT	OCT$	PEEK
	POS	RIGHT$	RND	SEARCH
	SGN	SIN	SPACE$	SPC
	SQR	STR$	TAB	TAN
	USR	VAL		
SPECIAL FUNCTIONS:	DISK	DO	FILE	TYPE
	RECORD			
LOGICAL OPERATIONS:	AND	NOT	OR	

New Basic, con't . . .

locations. The manual indicates that this could be useful in machine language routines, but implies that the current version does not fully implement this feature.

FILE specifies the number of the file being used, ranging from 0 to 63.

TYPE is used in Open statements to specify either sequential or random access type files.

RECORD serves a dual function. Used in an OPEN statement, it specifies the number of bytes per record. In a GET or PUT statement, RECORD specifies the number of the randomly accessed record upon which to operate. Record numbers start at 1. A useful feature is that RECORD (0) makes the next character transfer take place immediately after the last character transferred, much like a sequential operation.

By now you can see that Tarbell BASIC contains many features not included in any other microprocessor BASIC. Nevertheless, there are many enhancements which are available in other BASICs which would further increase Tarbell BASIC's power. Some worthwhile additions would include WHILE-WEND REPEAT-UNTIL, COMMON, ON-ERROR-GOTO, SWAP, TRACE, RANDOMIZE MIN/MAX and FIX. Other interesting additions might include integer variables, multi-line functions (although the GOPROC structure makes construction of similar routines possible), passing arrays to subroutines, overlays, XOR, simple cursor positioning, ARCSIN, uppercase conversion, etc.

Conclusion

I feel Tarbell BASIC's unique features make it possibly the best microprocessor BASIC for advanced users. The attributes which distinguish Tarbell from the others are not readily appreciated by beginners or intermediate programmers, although the language is certainly usable by such individuals. Those who have used FORTRAN, COBOL, or Pascal will welcome the alphanumeric line descriptors and parameter passing facilities, and anyone trained in structured programming will gain even more benefit.

It should be understood that Tarbell BASIC is a much "younger" language than the Big Three in that it is still undergoing intensive development and definition of its boundaries. Tarbell has released several versions in the last few months, each of which has included new features and been less prone to bugs. It is reasonable to expect interesting new developments in the future.

From a marketing point of view, it is unfortunate that Tarbell BASIC appears on the scene after its competition is so well entrenched. It may be unlikely that Tarbell will gain wide enough penetration for it to be a language used in mass software distribution or as a common dialect in the microcomputer buff publications.

This view in no way should dissuade anyone from purchasing the language. The CP/M version costs only $48. This is much less than either Microsoft Disk BASIC or CBASIC, and Tarbell offers an upgrade agreement for only $10. Note also that Tarbell will supply complete source code for only $25, a very attractive offer to advanced programmers who can modify a BASIC interpreter to include their own custom functions. I am not aware of source code being available from any other software supplier, certainly not at an affordable cost. On a cost basis alone, Tarbell BASIC makes a very interesting addition to a software library, and buyers may fine themselves becoming addicted to this very special BASIC. □

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CIRCLE 156 ON READER SERVICE CARD

A word processor for all systems

Auto Scribe

Jane A. Sellier

Talk about fun! I never had so much. My days as a frustrated office Secretary are over thanks to Auto Scribe, a software product offered by MicroSource in Tempe, Arizona. I am not technically oriented and, thank heavens, this program was designed to be easy to operate. It was planned from the operator's point of view and does not require computer knowledge for use. All typing is done on a video terminal which allows the operator to immediately correct errors and make changes in the text before printing.

The essential functions of Auto Scribe are:

- Create a new document
- Rapidly revise any document
- View the document on the video screen
- Delete documents from the disk
- Copy documents from one disk to another
- Assemble a document from pre-recorded paragraphs or pages
- Print a document

The days of laboriously typing letters, contracts, dissertations, etc., are over. Any typing project benefits from this system — even a short letter or a single-page document. The typist quickly gains confidence and is able to type at top speed all the time. This confidence comes from knowing that if an error is made, it can be corrected easily and "on the spot" before printing with the added plus of retaining a copy of the document on disk for later use.

When the Auto Scribe system first came into our office I was a little intimidated by all the paraphernalia. To put it bluntly, I felt dispensable (a feeling no secretary likes). My feelings were hurt. I thought my boss was trying to tell me something and that he just didn't have the nerve to tell me to shape up or ship out. Well, I was wrong! The old boy was actually trying to make things easier for me and was being helpful. I realized this only a few days after the installation and now thank him from the bottom of my heart.

Obviously, the first skill the operator must acquire is learning how to turn the system on. Plugging the system in, pressing the right buttons, inserting the diskette in the proper drive and knowing how to read the "Menu."

The system we use is made up of the following:

a. North Star HORIZON with Z-80 processor, 32K static high-speed RAM memory and two serial interface ports (see Figure 1).
b. Dual minifloppy disk drives.
c. Soroc video display terminal.
d. Printer (ours is a NEC Spinwriter).
e. Auto Scribe software on two magnetic minifloppy diskettes and the Auto Scribe operations manual.

The system is easy to use and requires only the standard office 110-volt, 3-prong power source.

Once the hardware is working, the operator mounts a diskette in Drive 1. The next step is to momentarily depress the red "Reset" switch on the computer and Auto Scribe is automatically loaded and run due to the Horizon's "auto-boot" feature.

The first message that appears on the video screen is "System Working." This is a great comfort. Pat yourself on the back and grin from ear to ear. This reassuring remark appears at various times during operation of the system to let you know that "all systems are go" and that you haven't loused anything up. It certainly beats starting at a blank screen and wondering whether or not all is well.

You will then see the following MENU displayed on the screen:

AUTOSCRIBE I
A WORD PROCESSOR VER 4.0
STARTING MENU
ENTER "C" TO CREATE A DOCUMENT
"R" TO REVISE A DOCUMENT
"V" TO VIEW A DOCUMENT
"D" FOR DISK PROCEDURES

Now, suppose you have to get a letter out. Depress "C" for Create and the display will ask you for the name of your document. You can insert up to 25 characters in this space and I usually put in something like "John Jones Letter" or "Manual Part 1" or something else that will let me know at a glance what it is. A video display pops up stating that you are in the Create Mode of operation at which time you depress the letter "I" to insert text. I like the simplicity of all this — "C" for create, "I" for insert, etc. Now that you and the machine understand each other, you can begin to write your letter. The manual that accompanies Auto Scribe is extremely clear and helpful and for the first few days (week) I held it on my lap between me and the

Jane A. Sellier, SELCO, Inc., 525 St. Francois, Suite 13, Florissant, MO 63031.

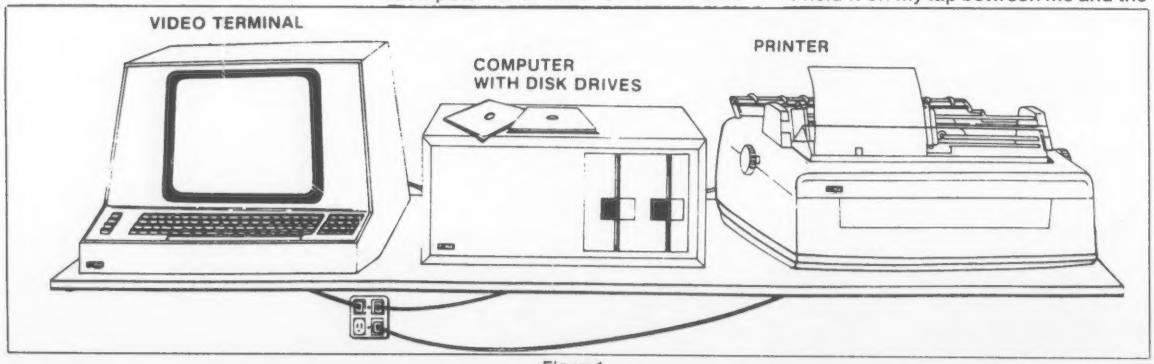

Figure 1

Auto Scribe, con't...

video display terminal, shuffling pages back and forth at a furious pace. I finally learned that the gold pages are for "Create," the beige pages are for "Revisions," the green pages are for "Viewing," and the blue pages for "Disk procedures."

If at any time during insertion of text in the "Create" mode of operation, you make a mistake, you simply depress the "back" arrow on the keyboard and move the cursor back to where the error occurred, correct the error and go on.

When you've finished entering data and you're anxious to see how well you did (or did not do), depress "F" on the keyboard. That will make things buzz and pop for a second or two and the Create Mode will stop. All the text entered up to this point will be stored on a diskette under the document name that you entered at the start.

The next step is to produce a letter (document, etc.) that is free of erasures, white-out gunk, Correct-O-Type dust and other methods that are normally used to get a good copy. Once again, the Auto Scribe makes it easy. It doesn't allow you to correct errors as you go along in the "Create" Mode (and this might be considered a drawback by some.) After leaving the "Create" mode the menu will be displayed again. This time depress "R" for (you guessed it) "Revise." All you do here is enter the document number you wish to revise (all the documents you have named are automatically numbered by the machine) and re-name the document when asked to do so. I usually put in something like "John Jones Letter 2" or "Manual Part I-2." The number at the end identifies the most recent version of the document. In the "Revise" Mode you can really clean up your text and make it look pretty. All kinds of things are possible. You can insert letters, words, paragraphs, or pages easily by depressing "I" for "insert," keying in the proper insertions, hitting the "Escape" Key and viewing your corrections on the screen. For instance, if you left the letter "a" out of "cat," you move the cursor to the "t," depress the "I" for "insert," depress "a," (the letter you left out), hit the "Escape" Key and the screen will display your correction. Or maybe you spelled it "catt" instead of "cat." In that event, you want to get rid of one of the t's. Move the cursor to the "t" you want removed, depress "D" for "delete," hit the "Rub" key and it is automatically taken out. If your document totals more than one page and you want to see it all, depress "N" for "next" and the screen will display the next page for you. If nothing happens you are at the end of the document, in which case you press "F" to "Finish" the revision.

```
\L55
10 December 1979
<
<
<
<
\L15<
Mr. Joe Blow
11 Any Street
Any Town, U.S.A. 11223
<
<
Dear Joe,
< .
<
\JR<
     Thank you for your interest in our tree houses.  We have
had overwhelming success with this addition to our new line of
products.  As we discussed in our telephone conversation, it
can be assembled quickly and easily and the price is quite
reasonable too!  Even your children could put it together in
a few hours.  I am enclosing some literature for you to look
over and I hope this will help you decide which model tree
house is best suited to your family's needs.<
<
<
<
<
\L55
Sincerely,
<
<
<
<
Sammy Schister
V.P. Tree House Division
\L15
SS/bs
<
Enclosure
```

Figure 2

I must warn you, however, that a certain cockiness on your part will set in and you'll begin to feel like the proverbial magician who is anxious to amaze all his friends and acquaintances with his wondrous powers.

Once you've convinced yourself that the thing won't blow up in your face and there's really nothing to fear from it, you'll want to see your revision. Press "F" for "Finish" and the "Menu" will be displayed again. This time (just to test your prowess) depress "V" for "View." Select the number of the document you wish to view on the screen and press "Return." Up pops your revision ready to be printed! At the right hand side of the screen you'll notice it's telling you that the printer is off. In order to turn it on depress the letter "P." Once this is done, you will see that the screen now tells you that the printer is on. The letter "P" acts as an "on/off" switch for the printer. The final step is to depress "F" for "Finish" and, if all goes well, the printer will take off and produce a copy of your document. In our office, we use this first printer copy of a document for our files after we've checked it one last time. You can revise it further if you notice any errors at this point.

Now let's talk a little about the flexibility of the format controls you'll want to use when creating a new document. This simply means that you have control over such things as page margins, page length, or whether or not you want certain words or paragraphs of your document centered within the text. Format Control Commands are always indicated by a Backslash followed by a letter or a number. The page-format parameters may be changed at any time while creating the document or you can insert them when in the Revision Mode of operation. In other words, if you goof, there's no need to despair. If you forget to give the format command for text you want to center — no matter. Enter the Revise Mode and give the computer your instructions that way. Again, the manual is explicit and, before long, you'll be a whiz. Figure 2 illustrates this more graphically.

New operators of Auto Scribe will occasionally feel that the system is not performing properly when, in fact, it is performing exactly as it was designed. For this reason, it's extremely important that the entire manual be read prior to attempting to use the program. Auto Scribe was designed to be easy to operate and, I feel, it is — and a whole lot of fun besides. I hope you enjoy using it too. □

Auto Scribe is available on North Star, Vector Graphics, Heath Data Systems, Apple, TRS-80, CP/M, Cromemco, Data General and Micro NOVA systems from: Micro-source, 1425 W. 12th Pl., Tempe, AZ 85281.

A Critical Evaluation

6800 BASICs

Ron Anderson

Until recently, only one BASIC interpreter has been available for the Southwest Technical Products Microcomputer system. The original, and very nearly free, one by Robert Uiterwyck is a very good one, but could be called the "slowest BASIC in the West" (or the East, too, for that matter). Recently several alternative BASIC's have become available, three of which will be reviewed and described here. Since most SWTPC owners are well familiar with the original BASIC it will be used as a standard of comparison.

Probably some of us were fooled into believing that the slowness of BASIC on our machines was indicative of an inherent limitation of the 6800 as compared to the faster BASIC's that ran on the 8080 and 6502 processor machines. As you will see, that's so much "hogwash." Interestingly enough, the three BASIC's to be compared here all have sufficient differences that it will be sort of like comparing, if not apples and oranges, at least oranges, lemons and limes. The first of these to be discussed is the A/BASIC compiler from Microware. If you were interested in this version when it was first released, you may have a release that had a few bugs. The later disk version has most all of the bugs resolved. Along the line of compilers, there is another contender, the STRUBAL compiler from Hemenway Associates. Strubal doesn't look much like BASIC. The name STRUBAL is derived from STRuctured BAsic Language. Lastly, we will get a look at TSC's new BASIC for the SWTPC system.

A/BASIC Compiler

The A/BASIC compiler is a real BASIC. It deviates from the "rules" only in that it doesn't require line numbers on lines that are not referenced somewhere in the program. That is to say, if you have a GOTO 100 in the program, line 100 must be identified. A look at the manual will reveal that A/BASIC has a few limitations. It is an integer only BASIC. This is the largest limiting factor, but once you are convinced that you can do a lot without floating point, you will be amazed at the efficiency and speed of A/BASIC compiled programs. The arithmetic is double byte precision, and therefore limited to the range of -32768 to +32767. A year or so ago, one of the computer magazines had a "contest" to write a program in BASIC that would find the prime numbers between 1 and 1000 in the least possible time. The best I was ever able to do in SWTPC BASIC was about 4½ minutes. It is possible to take advantage of the integer limitation in A/BASIC since the primes are integers, and I was able to write a program that would find these primes in about 2 seconds, and have them all listed to my terminal at 9600 baud in a total elapsed time of around 4 seconds! The program is included here (see Program 1). Of course, my programming skills, which were zero about three years ago, have become sharper but, applying the same techniques using SWTPC BASIC, I wasn't able to do better than the old 4½ minutes.

There are one or two other limitations that should be mentioned. The IF-THEN statement only allows line numbers as the object of the THEN. That is, you cannot use a statement like IF A>B THEN PRINT "A IS GREATER THAN B". It is necessary to use IF A>B THEN 123 — 123 PRINT "A IS GREATER THAN B" — GOTO <LINE AFTER TEST>. You can also use the form IF-THEN-GOSUB, which can help keep you from destroying the order of a program being translated from SWTPC BASIC. There are many good string handling functions in this BASIC. In fact, there are a few more than are available in SWTPC BASIC. It is possible to read a whole line of data from a disk file and print it, regardless of the commas that usually delimit data items in a file line. This is done by reading a record from the file and then printing the contents of the string buffer. READ #2,BUF$ --- PRINT BUF$ will do the job. Multiple statements on a line are allowed, separated by a colon. Another interesting function is the SUBSTR. You may search, for example for the letter N in the string L$="ABCDEFGHIJKLMNOPQRSTUVWXYZ" by using A=SUBSTR(L$,"N"). This function will return the value 14 for A. That is, the position of the letter in the string will be returned. If the substring is not contained in the larger string, a zero is returned. The substring is not limited to a single letter, but may be any size less than the main string. When strings are dimensioned, their length is specified. When a string array is dimensioned, the string length and array size are specified. This is particularly nice in keeping memory usage down since all strings don't have to be dimensioned to be as long as the maximum as in SWTPC BASIC.

Most of the other features of A/BASIC are standard. There is provision for specifying the program starting address, and the addresses of the variables. In fact, you can assign an input port a variable name, and then read the port simply by including that variable in a calculation or a statement like PRINT A. There is provision for inserting machine code directly into the BASIC program, which is possible since the compiler compiles a line at a time. The efficiency of the compiler is excellent. An exact number is difficult to pin down, because it depends on the type of program. A good estimate would be about a factor of 2 over the same program in Assembler. I recently did a program that does only logic. It looks at a group of data from two input ports and calculates a group of outputs to be written to two other ports. The run time package for this was 7 bytes. If "run time" is not familiar to you, I can explain it this way. Certain routines are needed in almost any program. Those who do a lot of Assembler programming are familiar with some routines in

Some of us were fooled into believing that the slowness of BASIC on our machines was indicative of an inherent limitation of the 6800

Ron Anderson, 3540 Sturbridge Ct., Ann Arbor, MI, 48105.

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BASICs, con't . . .

MIKBUG or SWTBUG that are referenced in most programs. These are run time packages. A/BASIC has a library of routines that are compiled only if needed in the program being compiled. For example, my logic program didn't have any math in the way of add, subtract, multiply, or divide, so the subroutines necessary to do those operations were not compiled. If you don't have string manipulations in your program, none of the string handling routines will be compiled.

The compiler is fast and easy to use. A listing may be generated that has the source listing with the memory location at which the code for each line starts. It is also possible to get a complete listing of the compiled code. It is informative to disassemble some of the compiled output. You will see that it looks just like "hand assembled" program. It is possible to insert error traps that allow your program to exit gracefully when an error is detected. It is also possible to indicate the type of error encountered by printing out the error number.

A/BASIC in the disk version also has extensive disk I/O capabilities. There seem to be some bugs in these when multiple file accesses are made, particularly when in subroutines. Most normal file accesses seem to work properly. In fact, I have been able to write a few utilities in A/BASIC.

Is this BASIC worth having around? I think so. I'm not much of a game nut, but I was able to translate the game of CHASE that involves printing out a map, and runs irritatingly slowly in old BASIC. The mapping is instantaneous, and the game suddenly becomes enjoyable to play. If it only had floating point and some Scientific functions . . .

STRUBAL and STRUBAL+

After some considerable delay, I have been able to obtain STRUBAL. There is a whole story there, but I now have it. My first impressions of STRUBAL were very negative. It is not very compatible with FLEX. There is no provision for use of the P command to get the output to the printer. The output goes to the printer alright, but so do all the prompts for input of filename, etc. After some frustration, I finally altered my PRINT.SYS routine so that everything that is printed is also output to the terminal. Since my terminal is running at 9600 baud, there is no slowdown because of this. Now, at least I can read the prompts and respond to them.

Strubal, as supplied, produces the final file as a multi-step process. First the source file is created using your editor. At this time the compiler is used to produce a compiled file that is essentially a source file for the assembler. The Strubal Compiler includes a complete relocatable assembler. The next step is to use the compiled file as a source for an assembler pass. This produces a relocatable object file which must be loaded to memory using a linking loader. When it is loaded, prompts are given for load address etc. If you want to save the object file, you can use the SAVE utility to save the program from memory, I had a little problem with that. The Linking Loader didn't honor

Once you are convinced that you can do a lot without floating point, you will be amazed at the efficiency and speed of A/BASIC compiled programs.

the TTYSET parameters, and the program load address limits were the first thing output in the load map. They zipped right off the terminal screen before I could read them. No matter, there is provision for an output file in the loader. Next problem, the output file is in the standard punch format (S1 ETC). The obvious thing to do is search out the linefeed carriage return routine in the linking loader and change it to a jump to PCRLF in FLEX which keeps track of the lines output and initiates the pause. Now the load limits stop on the screen and I can use SAVE.

How about the efficiency? Terrible. I have a two page program in BASIC that contains lots of math and scientific functions. It translated easily to STRUBAL. Though I got about 12 errors per page, most of them turned out to be easily spotted syntax errors (if all else fails read the manual).

The BASIC version uses the 9K BASIC and the listing takes another K. Strubal compiles my program to 5K and uses 6K of run time package. That means that the STRUBAL compiled program is larger than the BASIC program and the interpreter together. Further, the compile process took over 10 minutes to get from the source to the final binary file which could be run. The program does some fairly complex vector manipulations. It runs 6 seconds in BASIC, and ran 6 seconds in STRUBAL. Apparently the floating point and scientific functions are not too fast. This same program runs 3 seconds in Computerware's SUPERBASIC. SuperBASIC is a straight interpreter that runs about twice as fast in general as SWTPC BASIC.

I have also written this program in assembler using TSC's floating point package to do the math. I've written some fast trig functions using the floating point to sum terms of an infinite series expansion. The assembler program runs about 1½K long, and the run time is a fraction of a second. This puts the "overhead ratio" of STRUBAL at about 7. That is the amount of memory required is about 7 times that required by the equivalent program in Assembly language. This is admittedly a worst case condition, since most of the STRUBAL run time packages are required for this program. STRUBAL does not do a library search and includes only those routines required for a particular program. It does, however, have several packages that are not loaded if not needed. This decision is left to the programmer at load time. There is a package required for all programs, about 2K long. The additional packages are required for floating point, scientific functions and file manipulations.

Variables may be defined as Integer, Floating point, or String. All variables but integer must be defined before they are used. Program 2 is a sample of a source program for STRUBAL. It doesn't look much like BASIC but the differences are slight. It allows the use of labels rather than line numbers. There is no REM statement, but any line started with a * in the label field is considered a comment. All the standard functions in BASIC are supported, though the syntax varies a bit. The comparison symbols, rather than the usual "<, >, =" are two letter mnemonics such as .GE. for greater than or equal, .NE. for not equal, etc. This is not much of a confusion factor, except that the "=" is still used in equations and assignment statements

When a string array is dimensioned, the string length and array size are specified. This is particularly nice in keeping memory usage down

such as "A = .SQR(10). Note that the period (.) is used to start all function names.

STRUBAL allows the skipping of lines in the source listing by using a blank comment line, and passes indenting along to the listing. One puzzling error occurred when I first started using STRUBAL. I finally discovered that I had been trying to use a variable name that had the same first letters as a keyword in STRUBAL. The compiler gets very confused when you do this. I knew about the limitation from reading the manual, but it is easy

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- ☐ Amateur Radio • Basic and Advanced
- ☐ Digital Electronics • Electronic Technology • Basic Electronics
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BASICs, con't . . .

to overlook. The compiler doesn't flag all occurrences of the name as errors, making the problem even more mysterious.

STRUBAL does not allow multiple statements per line which would tend to obscure the program structure.

The PRINT line syntax might be puzzling. The slash (/) causes a linefeed. Single quotes (') are used for literals rather than the (") used in BASIC. Commas separate the items in the print list. In the example the [6] is a format specification that indicates that 6 digits are to be printed with none after the decimal point. If the result were floating point, you would use [4.4], for example to specify four digits before and 4 after the decimal point. Leading and trailing zeros are suppressed, and the output positioned so the decimal points are aligned vertically if several lines of various values are printed. The TAB function is

```
PRIME NUMBER PROGRAM IN STRUBAL


*
* STRUBAL PRIME NUMBERS PROGRAM
*
       CSECT
       INTEGER PRIME(50),I,J,K,L,MAX,N,P
       CEND
*
* PRIME THE PRIMES
*
       PRIME(1)=1
       PRIME(2)=2
       PRIME(3)=3
*
*INITIALIZE NEXT PRIME POINTER
*
START  I=4
*
* ITEM COUNT FOR LINE
*
       J=4
*
* SWITCH FOR SAVE OF PRIMES TO SQRT OF MAX
*
       P=0
*
       PRINT/,'PRIME NUMBER PROGRAM',/
       INPUT 'LARGEST NUMBER',MAX,///
       IF MAX .EQ. 0 THEN EXIT
       PRINT [6],PRIME(1),PRIME(2),PRIME(3)
       K=5
       WHILE K.LE. MAX
          FOR L=3 TO K
*
* REDUCE ARRAY REFERENCES BY ASSIGNING CONSTANT
*
             N=PRIME(L)
*
             IF K .MOD N .EQ. 0 THEN SKIP
             IF N*N .GT. K THEN OUT
          NEXT L
OUT       PRINT [6],K
          IF P .NE. 0 THEN NOSAVE
          IF K*K .GT. MAX LET P=1
          LET PRIME(I)=K
NOSAVE    I=I+1
          J=J+1
          IF J .EQ. 9 GOSUB LINE
SKIP      K=K+2
       BLOCK
       PRINT //,'THERE ARE ',I-1,' PRIMES BETWEEN 1 AND ',MAX,'
       GOTO START
*
LINE   J=1
       PRINT /
       RETURN
EXIT   JMP $7103
       END
```

```
PRIME NUMBERS IN A/BASIC


       REM PRIME NUMBERS FROM 1 TO YOUR CHOICE UP TO
       REM THE LIMIT OF INTEGER ARITHMETIC
       REM

       OPT S

       BASE=$30
       DIM P(50),R(50),L(1),M(1),I(1)
       BASE=$800
       ON ERROR GOTO 90

       PRINT TAB(8)$ "PRIME NUMBER PROGRAM":PRINT
10     PRINT TAB(8)$"LARGEST NUMBER"$;:INPUT M
       I=4:P1=0
       P(1)=1:P(2)=2:P(3)=3:REM PRIME THE PRIMES
       R(1)=1:R(2)=2:R(3)=3
       PRINT TAB(8)$ " "$P(1)," "$P(2)," "$P(3)," "$

       FOR K=5 TO M STEP 2
          FOR L=3 TO K
             N=R(L):S=P(L)
20           Q=K
             Q=Q-N
             IF Q<=0 THEN 30:N=N+S:R(L)=N:GOTO 20
30           IF Q=0 THEN 60:REM NUMBER IS NOT PRIME
             IF S*S>K THEN 40:REM ONLY NEED TEST NUMBERS < SQRT OF K
          NEXT L

40        PRINT K," "$
          IF P1<>0 THEN 50:REM SWITCH AVOIDS TESTING REPEATEDLY
          IF K*K>M GOSUB 70
          P(I)=K:R(I)=K
50        I=I+1:REM COUNT PRIMES
          IF POS>70 GOSUB 80:REM SET LINE LENGTH
60     NEXT K
       PRINT:PRINT
       PRINT TAB(8)$"THERE ARE "$I-1$" PRIMES BETWEEN 1 AND "$M$"."
       PRINT
       GOTO 10
       STOP

       REM SUBROUTINES FOLLOW
70     P1=1:RETURN
80     PRINT:PRINT TAB(8)$;:RETURN
90     PRINT TAB(8)$ "ERROR # "$ERR:STOP
       END
```

```
PRIMES IN TSC BASIC


 10 REM PRIME NUMBER FINDING PROGRAM IN NEW BASIC
 20 REM INITIALIZE LINE LENGTH
 30 DIM PR(50)
 40 POKE HEX("4B"),HEX("FF")
 50 PRINT:PRINT"PRIME NUMBER PROGRAM."
 60 INPUT"LARGEST NUMBER",MX
 70 IF MX=0 THEN 1100
 80 INPUT "PRINT RESULTS",A$
 90 IF A$="Y" THEN GOSUB 310
100 IF A$="N" THEN GOSUB 320
110 I=4:J=4
120 PR(1)=1:PR(2)=2:PR(3)=3
130 PRINTPR(1),PR(2),PR(3),
140 FOR K=5 TO MX STEP 2
150 FOR L=3 TO K
160 N=PR(L)
170 IF K/N=INT(K/N) THEN 240
180 IF N*N>K THEN 200
190 NEXT L
200 PRINT K,
205 J=J+1
210 IF P<>0 THEN 240
220 IF K*K>MX THEN P=1
230 PR(I)=K
240 I=I+1
250 IF J=5 THEN PRINT:J=1
260 NEXT K
270 PRINT:PRINT"THERE ARE "$I-1$" PRIMES BETWEEN 1 AND "$MX$"."
280 P=0
290 PRINT:PRINT:PRINT
295 GOSUB 320
300 GOTO 50
310 POKE 0,0:RETURN
320 POKE 0,9:RETURN
330 REM POKE 0,0 PRINTER ON; POKE 0,9 PRINTER OFF
1100 END
```

BASICs, con't . . .

implemented by using >7 to indicate 7 spaces. Actually, it is more of a space function than a tab.

In my quest for more I was supplied with a copy of STRUBAL+ which has some additional features. It allows the defining of a function (like the DEF FNC(X)) in BASIC. I didn't mention the fact that STRUBAL's floating point is 10 digit precision. STRUBAL+ has provision for varying the precision from 4 to 14 digits! Supposedly, the math is faster with fewer digits. I couldn't see the difference in the vector program, though the presence of all the scientific functions probably obscured the time difference in the math. STRUBAL+ comes with a much improved manual. It has a page devoted to each instruction with application examples.

A LINKAGE EDITOR is supplied with STRUBAL+. This makes it possible to link programs and produce an output file that is straight binary, and not punch format, without actually loading the program to memory. It is a major advantage in capability, and unfortunately very complicated to use. The original Linking Loader is easier to use for straightforward linkage and load applications.

The language is pleasant to use. The output formatting is very nice, and the precision excellent. You don't know what you are missing until you have used labels for references rather than line numbers, and had the luxury of assigning names to variables. The cost of STRUBAL is $100, but it is no longer being sold. STRUBAL+ is $280. In my opinion, STRUBAL is not a practical development tool because of the inefficiencies of memory usage. A program of more than about 4 pages would result in a compiled assembler source file of more than a full mini-floppy disk. Jack is obviously approaching the problem from the other end of the spectrum than Ken Kaplan at Microware with A/BASIC. The Linkage Loader was written in STRUBAL+. It is about 12K long. It works very well, but is huge, cumbersome and slow. On the other hand, 14 digit precision is hard to come by and it is here if you need it. STRUBAL+ might be a good language to use to design a small business system built around a 6800 system with 48K and a couple of 8 inch disk drives. As a development tool for programs to be put in ROM for an end product, it is sadly lacking. Whether it is worth the price is up to you. By the way, the prime number program that uses only integer arithmetic in STRUBAL runs almost as fast as the A/BASIC version, (9 sec.) and is about 4 times as large in terms of memory usage.

A/BASIC has a library of routines that are compiled only if needed in the program being compiled.

TSC New BASIC

This BASIC started out to be a compiler, and ended up an interpreter. When a source file is loaded, the interpreter generates an intermediate code file. It substitutes hex codes for the keywords, etc. The intermediate code is somewhat mysterious. I have a pre-disk version, essentially the cassette version revised very slightly to allow saving and loading the intermediate code files to disk. The features are roughly the same as the old BASIC. The incredible thing about this BASIC is its speed. Some time ago, one of the computer magazines ran tests of several systems using some benchmark test programs. This new BASIC is faster than a Z-80 basic running at 4 Mhz, and about ⅔ as fast as the fastest tested, the OSI BASIC for the 6502 running at 2 Mhz. If you have a 2 Mhz 6800 system, you can have the fastest BASIC for any Microcomputer. SWTPC BASIC was very near the bottom of the list in these tests.

What do you pay for this speed? The arithmetic is 6 digits. Actually the internal arithmetic is 7 digits and the results are rounded to 6. TSC has taken great pains to see that you don't get results like 2+2=3.99999, as happens in some other BASIC interpreters that use binary floating point arithmetic internally, as theirs does. They have hidden the binary so well, that you can find prime numbers by dividing and checking the result for it's being an integer. Some of the binary arithmetic BASIC interpreters won't do this. There is no DIGITS command, so you can't control the printout of such as dollars and cents directly. You can round by using PRINT INT(A*100+.5)/100 but if the "cents" come out even, the zeros will be dropped. Dan Vanada of TSC indicates that the final disk version will allow the use of all the FLEX system utilities without leaving BASIC. If you have FLEX2 operating this means that you can run any of the utilities. (In MINIFLEX some of the utilities load at $100 and would destroy BASIC.)

There is not a whole lot more that can be said about this BASIC except that outside of the differences explained above, it has all of the features of the old BASIC. It worked flawlessly for me. TSC has also made it conform more closely to the ANSI standard. It now treats a comma properly in a print list. If a line to be printed is ended with a comma, the linefeed is inhibited, and the next item is printed in the next zone. The old BASIC worked properly with a semi-colon, but went to the next line on a comma. This BASIC also allows an array subscript of zero. This will be of great help when translating a program from another BASIC in which these are allowed. You don't have to use them, but you must remember that if you dimension A(10) you will have A(0) through A(9) available. To avoid a problem when you translate an old program you can simply increase the dimension by 1 and not use the (0) location.

In keeping with the other two programs presented here, program 3 is the "Find the Primes" program in the new BASIC. This version runs 42 seconds to find the prime numbers from 1 to 1000. If that seems slow compared to the compilers, let me remind you that both compilers have integer only capability that may be taken advantage of. Also remember that this is more than six times faster than the old BASIC. Just for the record, this program in Computerware's SUPERBASIC also runs about twice as fast as SWTPC "coming" in around 2 minutes and 20 seconds.

The compiler is fast and easy to use.

TSC has indicated the availability of an Extended BASIC some time this summer. It will have "print using" capability, and 12 digit arithmetic. It will not be as fast but will be well suited to business applications.

The interpreter is about 9.5K long. TSC started out to produce a compiler, but found the run time package growing larger and larger, and so abandoned the original project in favor of the interpreter. They are to be commended on producing a major breakthrough in software that reveals the true potential of the 6800.

Conclusions

If you are perplexed at this point, so am I. These three BASIC's are all different. I had hoped for a compiler that could be used to implement some rather complicated math in ROM so it could be installed in a microprocessor based product. It would seem superfluous to install an 8K or 9K interpreter in ROM just to avoid writing 3K of assembler program. As you have seen, A/BASIC suffers from limited capability; though what it does, it does very well. STRUBAL has all the capabilities, but suffers from inefficiency and slow execution. TSC's new BASIC is fast enough and has all the capabilities, but

BASICs, con't . . .

has a 9.5K interpreter attached. Perhaps the problem is insoluble. Maybe no one can write an efficient compiler around a Microprocessor with the capabilities of the 6800. Perhaps it will take the 6809 or one of the 16 bit processors to do the job. Meanwhile, any of the above are great fun. Take your choice, or get one of each as I did.

I am looking at these from a particular point of view because I have a particular application in mind. Perhaps you have a different perspective, and this article will help you to find just the software you need for your application.

Update

Since this was written, TSC has released the disk version of BASIC. As promised, the FLEX Utilities are all accessible from BASIC. The FLEX2 version has several random access file modes including "virtual arrays" and "record I/O" as well as all the previous sequential files. It should be noted that only the FLEX2 version has these and not the Miniflex version. Time has not permitted trying these yet. TSC also foresaw a difficulty with array dimension compatibility in converting old programs. The new BASIC allows zero subscripts. Normally when zero subscripts are used, dimensioning an array as A(10) would reserve A(0) through A(9). Most of our old programs would expect to use A(1) through A(10). TSC chose to waste a bit of memory and save us some confusion. DIM A(10) reserves eleven locations, A(0) through A(10). Consequently there is no confusion, and A(0) need not be used, though we will learn to take advantage of it as we write new programs in the new BASIC.

Old source files created by the old BASIC contain some control characters that foul up this BASIC, and they must be passed through the Editor, which ignores control characters, before they will run in the new BASIC. Old programs that have any DIGITS=, LINE=, OR PORT= commands must also be deleted because this BASIC does not support any of these commands, and their inclusion results in an error when the program is loaded.

One inconvenience that I noted is that if you try to load a program with one of these or a simple syntax error, an error message is returned, and a 'LIST' command will reveal to you the successfully loaded part of the program up to and including the line BEFORE the one that contains the error. It is then necessary to exit BASIC and go into the Editor to correct the bad line. It would be much nicer if the bad lines would load so that they could be edited in BASIC. The rejection of a bad line is a nice feature while entering programs when in BASIC, but most of us will use the Editor at least for the first try at entering a program.

TSC has also provided a way (though a step backward in my opinion) to output to a printer. Rather than 'PORT=7' one uses the special output channel '0' by inserting the instruction OPEN "0.PRINT" AS 0. The manual is rather confusing on this as the 0 and O are not distinguishable from each other in the text. After 0 is opened, output is sent to the printer by using PRINT #0,"TEXT ETC.". A line that has simply the keyword PRINT always goes to the terminal. If you do not open

I had been trying to use a variable name that had the same first letters as a Keyword in STRUBAL. The compiler gets very confused when you do this.

0, or if after output to the printer you CLOSE 0, all output goes to the terminal again. The reason I think this is a step in reverse, is that extensive modification (editing) is required to convert a program where the PORT commands were used. The OPEN "0.PRINT" results in your PRINT.SYS file being loaded and the printer initialization taking place. If you CLOSE0 and then open it again in response to prompts in your program, PRINT.SYS will be again loaded from your disk and the process repeated. It seems rather incompatible with this very fast BASIC to be stopping to load a disk file whenever the PRINT to printer is turned on. Several of my programs have prompts for printer such that printer output is turned on as requested and turned off at the end of the program, when the program loops back to the beginning, the prompt again appears and the choice is again made.

Software available from:
Microware Systems Corporation
P.O. Box 4865
Des Moines, IA 50304
(515) 265-6121

A/BASIC compiler Extended Disk Version $150
(SSB, SWTPC, MDOS)
A/BASIC Cassette Version $65
(requires RT/68 operating system available in ROM for $55.
Contact Microware for catalog and details.)

Hemenway Associates, Inc.
101 Tremont St., Suite 208
Boston, MA 02108
(617) 426-1931

STRUBAL + compiler $249.95
(This is a price reduction from the previous $280.)

Technical Systems Consultants
P.O. Box 2574
West Lafayette, IN 47906

AP68-11	
TSC BASIC w/cassette	$39.95
AP68-11D	
With miniFLEX disk	$49.95
AP68-11F	
With 8" FLEX 1.0 disk	$59.95
AP68-11F2	
With 5" FLEX 2.0 disk	$54.95

Response from Robert D. Grappel of Hemenway Associates, Inc.

Hemenway Associates appreciates this opportunity to comment on the review by Ron Anderson of our STRUBAL+ language. We feel that this negative attitude is due to a difficult slant on the relative merits of languages/compilers than that which guided the design of STRUBAL+.

First, Ron mentions that the compiler and Linking Loader do not make use of all the features of the FLEX operating system. This is true. However, since all Hemenway Associates products are supplied for FLEX 1.0, SmokeSignals DOS, PERCOM MiniDOS, ICOM FDOS, TANO COPS11, and our own system CP/68, they had to be written for the most common denominator of these operating systems. Ron mentions that the Linking Loader outputs files in the Motorola S1 format. This is the standard format for 6800 systems: that FLEX cannot support it is more a deficiency of FLEX than a problem with the loader. The trouble with the P command is specific to the FLEX version. Under our CP/68 the printer prints listings and the terminal gets the prompts. Note that each of the other BASICs described "live" in only one operating system.

STRUBAL+ is not intended to be a BASIC compiler. The language was designed to include all the functionality of BASIC, but to change where change seemed beneficial and to extend where extensions seemed useful. Line numbers were eliminated and replaced with labels for enhanced readability. I/O formatting uses FORTRAN-like constructs. Structured forms are included. Data records (mixed data type structures) were taken from COBOL. STRUBAL+ can

BASICs, con't . . .

directly manipulate the stack which allows writing recursive subroutines . . . try that with a BASIC.

Ron points out that STRUBAL+ floating-point is fairly slow - about as fast as SWTPC BASIC. Some of this is due to the use of 14-digit BCD arithmetic - the accuracy necessary for business applications; maintaining control over the accuracy of the calculations can be a big help in some scientific problems, too. In a program which uses mostly floating-point arithmetic, STRUBAL+ will show no speed benefit over an interpreter. This is because both are spending nearly all their time doing the arithmetic. The rest of the program (compiled or interpretered) is taking negligible time. In integer manipulations or logic, STRUBAL+ can keep up with the fastest languages (as Ron mentions in his comparison with A-BASIC).

Ron's comments about the size inefficiency of STRUBAL+ need clarification. STRUBAL+ compiles a program by writing an assembly language equivalent to disk. This file is then assembled in subsequent passes of the compiler. Assembly language does tend to be space inefficient . . . but it is readable by the programmer.

Ron gives figures for the memory size of STRUBAL+ programs versus other languages. This is somewhat misleading. STRUBAL+ was never intended for writing small game programs or one-page programs. It is designed for writing large complex programs which need the power it provides. A 16K STRUBAL+ program needs no more runtime support than a 5K program and the larger the source program, the better STRUBAL+ will appear. Also, since STRUBAL+ provides the facilities for writing programs as modules and linking them together at load time, there is no need for huge files on disk when several smaller files will do. This linking process allows for flexibility. True, there are 20 commands in the Linkage Editor, but powerful software requires handles for the programmer to manipulate it.

Ron has some factual mistakes in his article. STRUBAL+ was never $280.00, it always has sold for $249.95. The Linking Loader is no longer sold. (Use the Linkage Editor instead.) The Linkage Editor can perform library searches.

One final point, perhaps the most important of them all, the source-code of the STRUBAL+ compiler, and all its runtime libraries, is available as a book, including the manuals and algorithm descriptions ($49.95). This will allow programmers to optimize the floating-point, change the I/O, or just learn how one compiler works. □

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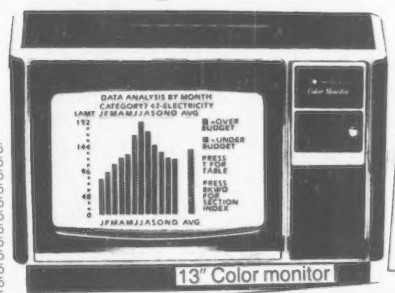

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Micro Music for the TRS-80

Jim Wright

Beethoven won't have to worry just yet, but Radio Shack is attempting to create a whole new breed of musicians. For $9.95 you can buy Radio Shack's new Micro Music (program #26-1902) and within minutes have your TRS-80 playing music. Micro Music can be played on any Level I or Level II TRS-80 by recording your composition on tape and replaying the tape in the normal fashion; or you can have your orchestration played directly through your hi-fi and watch your friend's expressions when you hit ENTER on the keyboard and your whole room fills with computer generated music. For the "in-betweener" the Micro Music manual indicates that you can buy the small Realistic #277-1008 amplifier ($10.95) for listening to the music. It appears that the AUX cable of the TRS-80 will plug directly into the Realistic amplifier; however, if you want to interface with another amplifier you will probably need to buy or make a cable.

Beethoven won't have to worry just yet, but Radio Shack is attempting to create a whole new breed of musicians.

Don't worry if you are not a musician or can't read music. The 8 page instruction manual will have you programming music within a few minutes. After an hour or so you will be scurrying through all the old music books you have looking for songs to enter into the TRS-80. While the manual is very thorough in teaching Micro Music's operation, I felt that it could have included a section on basic music fundamentals and reading simple sheet music for those who don't know or can't remember the differences between a half rest, quarter rest, eighth rest, etc. (The manual does include one line of sheet music converted into Micro Music coding as a sample.)

Programming Micro Music is amazingly simple. If you can read notes from sheet music you need only type in the note and duration (e.g., half, quarter, eighth, or whole — Micro Music does not allow for sixteenth notes). If you can't read sheet music, the manual provides a large chart that will allow you to look up each note to determine if it is a C, D, E, F, G, A, or B. The manual does not, however, help you in reading sharps or flats. I find most of mine when I play the music back the first time. Figure 1 shows a sample of the Micro Music conversions. To change from one octave to another you simply press <SHIFT>↑ or <SHIFT>↓ depending on the direction. Micro Music has a five octave range, but only three octaves are programmed. The five octave range allows you to play your composition in either the high range or base range. I used this range transition to program the beginning of "Dueling Banjos" for quite a dramatic effect. Sharps and flats are handled by inserting a # (sharp) or - (flat) directly after the note (e.g., F#4, B-8). Dotted notes are also provided for along with a stacatto effect (a very short pause between notes) and the capability to handle triplets (playing three notes in the normal time it takes for two). You can program two basic tempos (speed); however, by combining these with the triplet speed up you can actually generate four tempos. Additional options allow you to choose from three types of tones, to me they all sound like those in "Close Encounters." Finally, Micro Music allows you to repeat sections by enclosing the section in parentheses along with a number up to 9.

When typing in your music you can move the cursor in any direction using the four arrow keys. This allows you to quickly move around the screen and correct or add to your composition. <SHIFT> D will delete a character and <SHIFT> I will create a blank space allowing you to insert a character. To listen to your composition simply press <ENTER> and whatever you have entered will be played. If you like, you can record your music on tape. You can also record your program steps on tape for later reading back into Micro Music.

The 8 page instruction manual will have you programming music within a few minutes.

After using Micro Music for some time, I have only one real criticism of the program. Whenever you press <ENTER> to listen to a portion of your program, Micro Music will play everything that has been entered. This can be very time-consuming and annoying when trying to compose or debug a long piece of music. I would like to see a way to start a composition at any point in the music. One other problem I ran into is after writing or reading a program on tape Micro Music returns a "@" symbol. This symbol will appear in the position that the cursor was last in. Occasionally, this position was over one of my notes causing the note to be replaced by "@". When running the composition, I found that a note was missing and had to go back and reinsert the correct note.

Overall, I found Micro Music to be an interesting and fun program and would recommend it for anyone who would like to have their TRS-80 play music. While Micro Music is quite flexible, it is easy to operate and can be enjoyed by any TRS-80 user. It is one program that will be sure to answer the age old question ". . . but, what will it do." Composing your own music is a very satisfying and creative outlet that will bring hours of enjoyment to you . . . and those listening. □
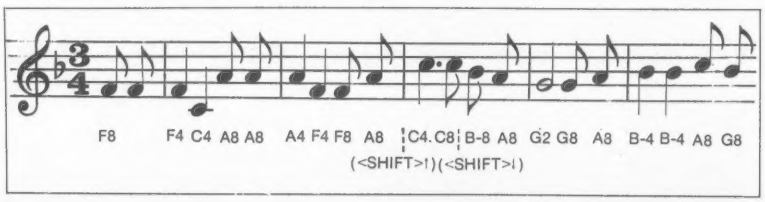
Figure 1.
Example of MICRO MUSIC programming <SHIFT>↑ & <SHIFT>↓ changes octaves The "-" in B- indicates a B flat.

Jim Wright, 10140 N.W. 43rd St., Coral Springs, FL 33065.

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A retail store cash register/inventory program

Evaluating "Register"

Gene F. Sellier

Register is a Cash Register/ Inventory Control Program for a small retail store to prepare sales tickets, accumulate sales information and adjust inventory at the time of sale. It also provides daily reports of sales activity and current status of inventory items at or below reorder point. Routines are provided to perform inventory functions such as ordering or receiving products, adding or deleting items, full inventory listing and producing a price book.

The Programs

The package is comprised of two functions — Inventory and Sales Processing. Let's look at the inventory process first. There are four programs that are used to maintain the inventory (Figures 1 and 2 list the programs and files on the program and data disc, respectively).

1. IRPT prints a detail listing of the master file (shown in Figure 3).
2. IRPT1 produces a price book with current quantity on hand (see Figure 4).
3. IENTRY provides the utility to maintain the inventory data base by adding new items and changing existing items.
4. ORDREC is used to indicate product ordered or received.

```
A2SI0-2     4   10 S    0
BASIC      14   45 S    1 2A00
CLOSEOUT  106   17 S    2
IENTRY     59   11 S    2
IRPT      123    7 S    2
IRPT1      70    6 S    2
ORDREC    130    9 S    2
REGISTER   76   30 S    2
```

Figure 1

```
FILE        4  256 S    3
DATA      271   50 S    3
TEMP      260   10 S    3
PUSH      270    1 S    3
BIN       321   25 S    3
```

Figure 2

SELCO, Inc., 525 St. Francois, Suite 13, Florissant, MO 63031.

The Inventory Programs work quite well. The reports are nicely formatted and data entry routines function smoothly. All inventory information is contained in one file named "FILE" and all data on an individual unit is contained in a 70 byte record. The file is pre-initialized for 934 random access records. In short, the inventory programs seem to function as designed.

```
INVENTORY REPORT AS OF 06/14/79              THE XYZ COMPANY      PAGE  1

=============================================================================
INV NO.    DESCRIPTION                  R-LEVEL    R-QTY      MIN-BAL    COST
RETAIL                                  C-LEVEL    ORDERED    UNIT       TOTAL
=============================================================================

  1        7400     DUAL GATE             50        500          10        .12
   .30                                     920        500                  110.40

  2        74L00    IC                     0          0           0        .15
   .33                                      10         15                    1.50

  3        74LS00   IC                     0          0           0        .20
   .39                                       9         15                    1.80

  4        7401     IC                    10          0           0        .08
   .16                                      4          0                     .32
```

```
 17        74LS08   IC                     0          0           0        .00
   .47                                      5          0                     .00

 18        7409     IC                     0          0           0        .00
   .34                                     10          0                     .00

 19        7410     IC                     0          0           0        .00
   .23                                     500         0                     .00
```

Figure 3

```
INVENTORY REPORT AS OF 06/14/79              THE XYZ COMPANY      PAGE  1

=============================================================================
INV NO.    PART NO.          DESCRIPTION                  QUANTITY      PRICE
=============================================================================

    1      7400              DUAL GATE                       920         .30
    2      74L00             IC                               10         .33
    3      74LS00            IC                                9         .39
    4      7401              IC                                4         .16
    5      7402              IC                               60         .22
    6      74LS02            IC                                0         .41
    7      74LS03            IC                              124         .59
    8      7403              IC                               14         .21
   10      74L04             IC                                0         .44
   11      74LS04            IC                                0         .46
   12      74S04             IC                                0         .45
   13      7405              IC                                6         .24
   14      7406              IC                                5         .00
   15      7407              IC                                0         .44
   16      7408              IC                                7         .28
```

```
   49      7489              IC                                6        2.53
   50      7490              IC                              500         .95
   51      7493              IC                               21         .82
   52      74107             IC                                7         .45
   53      74LS109           IC                               13         .73
   54      74121             IC                                0         .49
   55      74122             IC                                0         .48
```

Figure 4

"Register", con't . . .

The most interesting application begins with using the Register Program. After setting the opening date, cash and ticket number, the Register Menu is displayed. Figure 5 shows the dialogue for completing a routine sales transaction and the resultant update to the cash drawer. [This illustration was produced by changing a conditional branch to an unconditional branch at memory location 10550 in the standard North Star Release 5 BASIC configured for a Horizon with two serial and one parallel ports. A FILL 10550,205 will copy data sent to the CRT on a printer connected to the right serial port. FILL 10550,202 restores print to the left serial port only. (Thank North Star for this useful tidbit.)] An unfortunate situation results from entering a command incorrectly. When the program is restarted, the cash drawer totals are somewhat modified. Starting cash is now the last total of the cash drawer. The Closeout program is shown in Figure 6. The amount of starting cash is correctly reflected under "Transactions."

Now that we have a general idea how the Register system works, we can try to evaluate the practical value of these programs. The first thing we must realize is that no offering such as Register is likely to match the requirements of every potential user-the crucial point is how close it comes to meeting our needs and how difficult it will be to modify the programs to produce the desired results.

Evaluating the Package

The first step in determining whether or not a particular piece of business software will be satisfactory is to clearly define the job that needs to be done. If you are unsure then seek professional advice from a CPA or other qualified professional. Do not assume that any software package will fulfill the necessary legal requirements for recordkeeping and documentation. The IRS holds you, the businessperson, responsible-not your accountant or the software house that wrote your business package. Most business software products carry a disclaimer against loss through the use of the package. In short, it's up to you to insure that your records are accurate and follow accepted accounting methods. So much for sermon.

For most retail or wholesale businesses, merchandise inventory represents the most sizable investment and is the most volatile. Lack of adequate control can produce losses that may cause business failure. The minimum information on an inventory item might be: 1) stock number; 2) description; 3) manufacturer's ordering number; 4) cost; 5) selling price (may be more than one); 6) reorder point; 7) minimum order quantity; 8) quantity on hand; 9) quantity on order; 10) date of last order; 11) backorder quantity (sold but not delivered); 12) General Ledger account or department number. Inventory reports required could include: 1) complete inventory listing; 2) price book; 3) backorder report; 4) minimum quantity report; 5) inventory investment by department and grand total; 6) audit trail of item entered into the data base; 7) audit trail of items removed from the data base by any method other than sales. This would not be a super comprehension inventory system but would provide most of the control necessary to manage a small to medium sized inventory base.

Does the inventory portion of Register meet these hypothetical minimum requirements? It's close but doesn't quite fill the bill. No provision is made for backorders (only important if you will accept a customer's order for product that you don't have on hand) or date of last order. The manufacturer's number could be part of the description. Complete inventory listing and price book are produced. The most serious deficiencies are in the area of documenting transactions. No hard copy results from either ordering or receiving products. Products can be removed from inventory by merely changing the quantity on hand figure with the CRT. This not only makes finding mistakes more difficult but it makes the system vulnerable to theft by dishonest employees. No system is foolproof but the temptation to steal can be reduced. The investment figures can only be obtained by printing the entire master file and no provisions for department totals have been made. Department or account numbers are important because they generally relate to a sales account number. Statistics such as "Profit by Sales Category" can be calculated by using the department totals. It would be a rare business that had only one General Ledger Account number for sales.

It's hard to compare Register to the action of a conventional cash register because it also manipulates inventory while producing a sales receipt. The time required to produce a sales receipt is considerably longer than using a cash register for a couple of reasons: (1) many more keystrokes are required and (2) each sales receipt is printed on 8½ inch x 11 inch paper. Printing speed is naturally dependent on the print rate of the printer attached to the system. The sales receipt contains a more complete description of the transaction than you normally receive on a cash register receipt. This is a plus and using two part form stock would provide an audit copy of all sales transactions that occurred in the system.

On most cash registers, functions such as Sub-Total, Total and Cancel are single keystrokes. Register requires from three to six keystrokes to perform the equivalent function and if you make an entry error, the program will crash. This can be remedied by changing the input codes to a single character for each function and performing a test to insure that a valid entry is made. This would also speed up the process somewhat making the program easier to run and more tolerant of operator error.

Summary

The really big question now is this: "Is Register worth $199.95?" The answer is a definite "It depends." If you have some business programming experience and a clear idea of what you want to achieve, then this program probably wouldn't be of particular value. The code almost looks like different people wrote the various modules or else the person who wrote it was learning and got progressively better. The Register module had one syntax error, a missing REM statement for a comment line, and is not what you would call structured programming. More like "put it down as you think of it." Exit from the Menu Display subroutines is a GOTO statement instead of RETURN. It is possible to get a Stack Overflow error under certain conditions. The other modules appear to be relatively straightforward and functional. An important point to remember is that, as a system, Register works, which is more than I can say about some other software products I've seen. If you're new to business programming and need a package like this, Register could be a good starting point for you. With time and revision, it could be a useful system. On a scale of one to ten, I'd rate this package at 4.13 (.13 above mediocre).

I hate to be critical of anyone's programming effort since I am only too aware of the time involved to produce a package. Christianson & Associates stated that this is an installer's package rather than an end user package-I agree. However, the advertising information included with

"Register", con't. . .

the package states that it is ready to run which to me means no modifications are necessary. If this package was priced at $50.00, I believe it would be a fair value-but not at $200.00.

Register is a software product offered by Gene Christianson & Associates, Box 267, Santa Barbara, CA 93102 for $199.95. The package reviewed was labeled "Version 1.0" and included one program diskette, one pre-initialized data diskette and a twenty-two page Operator's Manual. The programs are written in North Star BASIC and require a video display device and hard copy printer. Two disk drives are nice but not required. □

```
***** REGISTER *****  COPYRIGHT 1978 BY GENE CHRISTIANSON ASSOC.

DATE [CR=RELOAD DATA] > 04/04/79
STARTING CASH         > 250.00
STARTING TICKET NO.   > 1234
OK? [CR=YES]

REGISTER  COMMAND TABLE       04/04/79
-----------------------------------------------------
| CANCEL      CANCELS RECEIPT IN PROGRESS             |
| ENTER/$     ENTER ITEM NOT ON INVENTORY             |
| DEPOSIT/#   TAKE DEPOSIT ON PART AND PRINT TICKET   |
| PAYOUT      WRITE PAID OUT TICKET                   |
| TOT         TOTAL AND PRINT TICKET                  |
| SUB         PRINT SUBTOTAL TO SCREEN                |
| [CR]        PRINTS THIS PAGE                        |
| P/N         INVENTROY NUMBER TO BE FOUND            |
| P/N ?       DISPLAY ALL ITEMS CONTAINING P/N STRING |
| P/N *       FIND FIRST OCCURANCE OF P/N STRING      |
-----------------------------------------------------

Item   > 5

INVENTORY NO.    5
DESCRIPTION     7402    IC
STOCK ON HAND   72


PRICE             .22


HOW MANY ? 12
TAXABLE [Y/N CR=Y] ? Y

Item   > 4

INVENTORY NO.    4
DESCRIPTION     7401    IC
STOCK ON HAND   5


PRICE             .16


HOW MANY ? 1
TAXABLE [Y/N CR=Y] ? Y

Item   > 3

INVENTORY NO.    3
DESCRIPTION     74LS00  IC
STOCK ON HAND   10


PRICE             .39


HOW MANY ? 1
TAXABLE [Y/N CR=Y] ? Y

Item   > SUB
 QTY      INV. NO.  DESCRIPTION                  UNIT      TOTAL
-------------------------------------------------------------------
 12         5       7402    IC                   .22       2.64
 1          4       7401    IC                   .16        .16
 1          3       74LS00  IC                   .39        .39

                                        TAX                 .19
                                        TOTAL             $3.38

HIT [CR} TO CONTINUE

Item   > TOT
NAME [CR=CASH]      : JOHN DOE
ADDRESS             : 321 A STREET
CITY STATE ZIP      : WOMBAT CA 95555
OK ? [CR=YES]       :
```

```
                              GENE CHRISTIANSON ASSOC.
                                    BOX 267
                                SANTA BARBARA, CA. 93102
                                  PHONE 805/682-5693

          JOHN DOE
          321 A STREET
          WOMBAT CA 95555
                                  04/04/79                    NO.  1234

 QTY      INV. NO.  DESCRIPTION                  UNIT      TOTAL
-------------------------------------------------------------------
 12         5       7402    IC                   .22       2.64
 1          4       7401    IC                   .16        .16
 1          3       74LS00  IC                   .39        .39

                                        TAX                 .19
                                        TOTAL             $3.38

TICKET TOTAL          3.38
ENTER AMOUNT PAID > $5.00
                                    AMOUNT RCD             5.00
                                       BALANCE           $-1.62

YOUR CHANGE IS          $1.62
HIT [CR] TO CONTINUE

Item   > TOTX

                        ALPHA DATA SYSTEMS

04/04/79                          TICKET NO.  1235
=============================================================
TRANSACTIONS              1   STARTING CASH        $250.00
CASH DRAWER          $253.38   MINUS STARTING         $3.38
DEPOSITS               $.00   PAID OUTS              $.00
TAXABLE SALES          $3.19   NONTAXABLE SALES       $.00
=============================================================
HIT [CR] TO CONTINUE
```

Figure 5

```
***** CLOSEOUT *****  COPYRIGHT 1978 BY GENE CHRISTIANSON & ASSOC.

SET PRINTER AND HIT [CR]

================================================================================
                    GENE CHRISTIANSON & ASSOC.
                      CLOSEOUT REPORT
Report as of 04/04/79                                              Page  1
================================================================================
            *************** T R A N S A C T I O N S ***************

                    TRANSACTIONS                          2
                    CASH DRAWER                      $268.84
                    LESS STARTING CASH               $18.84

                    TAXABLE SALES                    $17.77
                    NONTAXABLE SALES                  $.00
                    DEPOSITS                          $.00
                    PAID OUTS                         $.00
          ***** I T E M S  N O T  O N  I N V E N T O R Y ********

NUMBER    DESCRIPTION                              QTY       PRICE          TOTAL
--------------------------------------------------------------------------------
          ******** I T E M S  T O  B E  R E O R D E R E D ********

NUMBER    DESCRIPTION                CURRENT LEVEL  REORDER QTY    LAST PRICE
--------------------------------------------------------------------------------
   4      7401       IC                      4            0          $.08
  34      7438       IC                      0            0          $.00
  67      74157      IC                      5            0          $.00
 122      A15B       GEN ELECT DIODE  5A 200 4            0          $.00
 145      DB25-P     EIA CONNECTOR           8           10          $1.76
 158      IQ120      SORROC TERMINAL         0            5        $765.00

             ************* C R I T I C A L  I T E M S **************

NUMBER    DESCRIPTION                CURRENT LEVEL  REORDER QTY    LAST PRICE
--------------------------------------------------------------------------------
   6      74LS02     IC                      0            0          $.00
  10      74L04      IC                      0            0          $.00
```

Figure 6

Response From Gene Christianson & Associates:

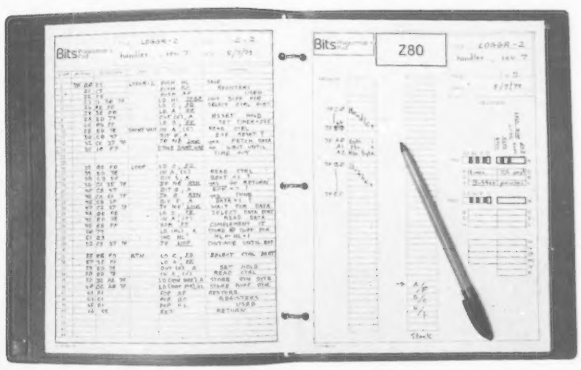
Thank you for the opportunity to comment on the Review of Register written by Mr. Sellier.

Mr. Sellier reviewed a version 1 copy of Register. We are now shipping version II which uses North Star 'PRINT #' routines as supplied by the end user. Menu dialog has also been shortened. We have also added more documentation to the software.

We are aware that a package can't be written to suit everyone's needs. users comments and suggestions are always welcomed.

Gene Christianson

BITS PROGRAMMER PADS™



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Small Business Computing

Chet Behrman

So you're thinking of going into business as a consultant and programmer for small business applications?

Twelve pages have been ripped off the wall calendar, signalling the completion of one year of making a living with the TRS-80. Everyone has his own definition of "making a living," so the statement is safe. Beginning in June, 1978, I officially launched a company offering microcomputer services in the Evansville, Indiana, area. The initial objectives have changed slightly, profits and peripherals have both grown, and the number of error messages continues to decrease.

I'm careful to avoid the "domino setup": Press this button and you start a routine that you wished you hadn't!

What started as a vague offer of "computer services" has now become a strong emphasis on custom business programming for the TRS-80. I've dabbled in games for national syndication, but the real money-maker has been programming and corporate hand-holding among small and not-so-small businesses in the area.

My situation isn't typical, but there must be some lessons to learn from the past twelve months. After spending more than thirty years in broadcasting, the last 22 as program manager of the NBC-TV station in Evansville, I made the move to a second career. In your mid-fifties, you don't fill out work application forms no matter what the EEO people say. So I turned to an old love - data processing - and a business of my own.

Two off-and-on years of computing science at the local university provided the official background, but I had been poking into computers and punchcards for more than two decades, always with broadcast applications in mind. In 1977, I decided to buy a microcomputer, and Radio Shack's announcement of the TRS-80 that fall prompted an immediate order.

Chet Behrman, The Program Manager,
PO Box 45, Inglefield, IN 47618.

Typical TRS-80 multi-drive business system.

Starting with Level I and a handful of cassettes I began feeding in some modified programs I had run on the IBM 370 and was pleased to see that the TRS-80 came up with the same answers. The decimal points weren't aligned, but PRINT USING was still a few months off.

When I saw Level II performance, the whole idea of making something practical out of the TRS-80 began to take shape. With a disk drive and a line printer on order, I sat down with 16K Level II and looked around the community. Without a printer, turning out reports is rough. (Although my first self-appointed assignment was a television syndication report laboriously copied off the CRT and sold to a number of TV stations around the country.) While waiting for a printer to materialize I struck up chatting acquaintances with all the Radio Shack managers in the area, including parts of Kentucky and Illinois. They mentioned potential customers who had come in to see the TRS-80, but they were properly reluctant to send me knocking on business doors in violation of Tandy policy.

A custom program is much like a painting - you never know when you're finished.

The New Business Computerists

So I literally followed the advice of, "Don't call us . . . we'll call you." The calls began coming in - from busi-

```
                        U. S.  TREASURY
                  PAYROLL FOR WEEK ENDING JULY 4 1777
   REG          OVT      FED       FICA      STATE      OTHER     NET

312-22-1732 GEORGE WASHINGTON  42 HRS 35 MINS
   190.00     18.41    19.88     12.78      3.01       2.25    170.49

305-11-1776 THOS JEFFERSON  40 HRS 0 MINS
   160.00      0.00     8.45      9.81      1.66       5.00    135.08

371-13-4848 BETSY ROSS  41 HRS 15 MINS
   150.00      7.03    23.11      9.63      2.76       1.15    120.38

302-04-1313 AARON BURR  42 HRS 10 MINS
   140.00     11.38    17.88      9.28      2.26       0.00    121.96

 TOTALS
   640.00     36.82    69.32     41.50      9.69       8.40    547.91


GROSS TOTALS:
GEORGE WASHINGTON          208.41
THOS JEFFERSON             160.00
BETSY ROSS                 157.03
AARON BURR                 151.38
   TOTAL PAID              676.82

12.26% TAX THIS WEEK IS    152.30

00/00/00
```

Figure 1. Sample custom payroll program.

Small Business, con't . . .

nesses that had already bought a TRS-80 and didn't know how to proceed from there - and from business people who were thinking of buying but needed more information about software possibilities. Since then, the prospect list has become a long one.

My first customer was a plumbers' local . . . asking for a mailing list program. Actually, what was termed a mailing list turned out to be a complete membership file, displaying and printing name, address, age, telephone number, card number, work classification, Social Security number, initiation date, apprentice/journeyman labels and active/retired designations. The program was set up to search the files by name, city, state, county, card number, work classification and active status. In these areas, it could print mailing labels, display on the screen, print lists and summarize classifications. All of this was done with 16K, one drive and a line printer; and they've just recently expanded to another drive.

Every TRS-80 user knows what waiting for equipment delivery is like; so the initial program for the union local was a Level I creation, using cassettes and CRT. Later, this was modified for Level II with printer, and then modified again for disk operation.

By the time my disk and printer arrived in the fall of 1978, local business was brisk. All of us learned later about the tremendous sales success of the TRS-80 in 1978; I was feeling that local impact, surprised at how many of the systems were being purchased in the area for business purposes.

The absence of business systems ready for demonstration in Radio Shack stores brought my clients and potential clients to my home for a hands-on demonstration. An all-day seminar set up by Radio Shack in downtown Evansville also spurred a great deal of business interest. People like to see the equipment, press the keys, and see CRT or printer response before they sign on the line.

The very fact that the TRS-80 (Model I) is modular makes a stand-by arrangement very attractive.

32K and two drives seem to be a good minimum layout for business with the Model I. The DOS takes a lot out of 16K, and I've since expanded my own layout to 32K. Even with a one-drive application, two drives ease the BACKUP chore — and BACKUPs do become a way of life. If inventory is involved, its size, of course, dictates the required number of drives.

Subsequent jobs included my own payroll program and a great variety of inventory approaches, including such diverse businesses as upholstery, light manufacturing, automotive parts, telephone answering, country club, beverage distributor and tax return preparer. One customer, a vending machine company, was lost due to a long wait for equipment. This was unfortunate because the application, processing a few hundred vending machines, was a natural for the TRS-TRS-80.

Custom Programming and Systems Analysis

The most difficult part of the past year hasn't been the programming but rather the systems analysis - understanding how the client operates. Actually, custom programming is the simplest approach - tailoring systems to the customer's particular needs rather than creating programs that must satisfy dozens of potentially conflicting situations. But learning what those needs are takes a great deal of consultation. My years of on-the-air interviewing have helped in keeping a discussion on the track and probing for hidden pieces of information. It isn't easy for people to explain to you what their business is all about. I listen, make notes, and then debrief myself into a cassette recorder (not the one that goes with the TRS-80!).

After initial discussions, an outline is prepared showing just what the system will do. (By that time, we're using the term "system" because a half a dozen or more individual programs are involved.) This is the critical point - getting the customer to agree that **this** is what he wants in the way of reports, and **this** is the type of entry required to feed the data into the files. The written proposal quickly pinpoints misunderstandings on either side, and it's revised, several times, if necessary, until an agreement is reached.

In the meantime, you've already turned out a few quickie demo programs with miniature files to give the customer an idea of what he can expect. To be honest, you point out that the larger, actual files won't process as fast as these smaller demo jobs. But, hopefully, he's still impressed. (The male pronoun is used for convenience. About half of my contacts have been female.)

MAXIMUM TRS-80 FILE SIZES

Sub Records	Bytes per Record	Records on DOS 2.1	Records on DOS 2.2*	Records on Full Disk
1	255	230	205	325
2	127	460	410	650
3	85	690	615	975
4	63	920	820	1300
5	51	1150	1025	1625
6	42	1380	1230	1950
7	36	1610	1435	2275
8	31	1840	1640	2600
9	28	2070	1845	2925
10	25	2300	2050	3250
11	23	2530	2255	3575
12	21	2760	2460	3900
13	19	2990	2665	4225
14	18	3220	2870	4550
15	17	3450	3075	4875

*DOS 2.2 figures refer to a disk with all accessible programs removed.

Table 1

Disk backups, yes . . . but the cassette is still a very efficient way of storing programs.

All of the consultation, demonstration and initial flowcharting is done while the customer is waiting for equipment delivery. As soon as it's delivered, initialization programs start him into the process of file building while you're working on the main program structure.

Then there's the question of space. One of the first questions asked by a potential customer is, "How many inventory pieces can you store on one disk?"

"It all depends" isn't a very satisfactory reply. I put together the chart in Table 1 which shows how many random records can be accommodated with a given record length. A record length of 44 bytes, for example, shows you can put a maximum of 1150 records on the TRS-80 DOS disk. Table 1 shows that an "open" disk with the same record length can accommodate 1625 records. This also means that if you can possibly shorten the record to 42 bytes, the DOS disk can be expanded to 1380 records. Without a long explanation of what a byte is, this is good, factual information that a would-be user can appreciate.

Small Business, con't . . .

User Programming

It's probably coincidence that the word "custom" is also found in the word "customer." Custom programming certainly keeps the customer in mind. In dealing with first-time users, especially, you assume nothing. You create the program to help the person at the terminal in what may be, to him or her, a rather frightening experience. If your opening menu has a choice of five options, be prepared for the user to choose a sixth option that doesn't exist. If choosing 6 automatically spills you to 1, you've done the user a disservice. Explanations on the screen have to be complete but concise, saving the detailed remarks for the written manual. INKEY can be a very fancy way to input data, but it can be confusing to a new user to whom you've emphasized again and again, "Be sure to press Enter after you've made your entry!"

I've even abandoned the time-honored word "menu" in favor of "select" and "master select" which seem to be more meaningful and less whimsical to a first-timer.

As far as user satisfaction is concerned, custom programming is difficult to beat.

I'm careful to avoid the "domino setup": Press this button and you start a routine that you wished you hadn't! For example, after the payroll is printed, the screen asks, "Are you ready to update the file?" In most cases, the answer is yes. But this gives the user a chance to backtrack on an unfortunate mistake and redo the entries without inevitably spilling all that wrong information into the file.

The true custom program, of course, needs less explanation than something off the shelf. The customer has already asked for many of the features that the program contains. Yet, documentation is still necessary. Every program has a date at the top. When a change is made, the date changes. Modifications are inevitable when you have a continuing working relationship. "Could you change it so that . . . ?" is a common question. So a custom program is much like a painting - you never know when you're finished. A dab here and a dab there, and the system becomes more and more polished.

Hardware Considerations

Equipment problems need some mention. When a disk drive or an interface act up, they're easy to remove and send off to a service center in another city. But a business user can't go down for two weeks or even two days without serious repercussions. If one drive in a four-drive system goes out, the program may be temporarily modified to limp along on three drives until the fourth is returned. But the real answer to this problem is standby equipment. This is not included in Radio Shack's policy: if there's a drive on the shelf, someone wants to buy it. However, the very fact that the TRS-80 (Model I) is modular makes a standby arrangement very attractive. The burden of such an arrangement probably falls on the company providing support; but it's to everyone's advantage - Radio Shack, the business user and the software supplier - that the system continues to operate.

When I saw Level II performance, the whole idea of making something practical out of the TRS-80 began to take shape.

In the 18 months I've worked with my own TRS-80, only one problem developed - a chip flaw in the CPU that knocked out the upper part of RAM. This was immediately correctable by designating full memory size, and the chip was eventually replaced.

APEX MANUFACTURING CO INVENTORY AS OF JUNE 29 1979

STOCK	VENDOR	VEND STOCK	DESCRIPTION	ON HAND	AVG COST	TOTAL VALUE
10024	93	800T-N40	RED LENS CAPS	5	48.50	242.50
10025	93	800T-XD1	CONTACTS	0	0.00	0.00
10026	93	800T-XD2	CONTACTS	21	13.95	292.92
10027	93	800T-XD5	CONTACTS	7	36.81	257.64
10028	93	800T-XD6	CONTACTS	15	18.52	277.80
10029	93	800T-N129	MUSHROOM HEAD GUARDS	2	126.72	253.44
10030	93	800T-N229	MOUNT RING KIT	12	20.84	250.08
10031	93	P271	SEL SWITCH KIT	1	242.75	242.75
10032	93	P272	SEL SWITCH KIT	2	124.15	248.30
10033	93	RRD	CONTACTS	12	22.40	268.80

TOTAL VALUE OF INVENTORY IS $2334.23

Figure 2. Sample custom inventory program.

Another system developed major problems finally traceable to a bent cable connector plus dive misalignment, but the majority of the systems have worked well. The chief annoying factor for the user is the disk read/write error message that breaks the program, yet I've seen systems turn out hour after hour of printouts without a single mishap.

One of my customers, an automotive parts company, eventually switched from a four-drive TRS-80 system to the Tandy 10, and the improved reliability of performance was immediately apparent. The Tandy 10 is a modified System 70 made by Applied Digital Data with the Tandy label attached. With its 8-inch disks and special-function keys it bears a striking operative resemblance to the new TRS-80 Model II. Or maybe it's the other way around. If the Model II can match the Tandy 10's reliability quotient (it already has a potential of twice the capacity of the Tandy 10), Radio Shack has another winner. The Tandy 10 has received little publicity and is reportedly being phased out, overshadowed now by the lower-priced Model II.

After the superb performance of Level II, one is somewhat taken aback by the appearance and reappearance of error messages in disk operation. Hopefully, the latest DOS version will ease some of this anxiety (and the introduction of 8-inch disks in the Model II may put it completely at rest). After losing two programs while SAVEing them - a read-write error spilling into the system level - I adopted a new practice. When I plan to spend an hour or two creating at the keyboard, I operate at Level II. When I'm finished, I feed it to a cassette, activate the disk system, CLOAD it into CPU and then SAVE it to the disk.

My first customer was a plumbers' local . . . asking for a mailing list program.

Although most of my business customers have abandoned their cassettes, I make active use of mine in storing programs. Disk backups, yes . . . but the cassette is still a very efficient way of storing programs. I have literally hundreds of programs, including various versions of a single program, stored on cassettes, with more than forty disks dedicated to individual clients and projects.

The Money Angles

How do you make money at all of this? Very deliberately! I give an initial estimate for programming a specific

Small Business, con't . . .

system. By a system I mean a series of related tasks, a working package, in other words. My programming rates have gone up this past year, not due to inflation but rather to a growing recognition of the time it takes to produce a quality system. I'd like to charge more, but charging more than hardware costs doesn't seem practical at this level of the profession.

In addition to programming charges, I request a monthly "service and support fee." This keeps me on call to answer questions, make minor program modifications, do a little hardware troubleshooting, and generally keep the system operating. So far, no one has really taken advantage of me on this. The support fee begins when the equipment arrives, and it serves a double purpose. One, it permits the customer to call me at any time without having to watch the clock and worry about a mounting hourly expense. Second, it prompts customer cooperation in putting the system together. If he drags his feet, calls off appointment after appointment, delays in initial file building, it costs him nothing but money. I already have the incentive to get the system operating as quickly as possible: I can't bill for programming until it's finished.

Custom programming is the simplest approach - tailoring systems to the customer's particular needs rather than creating programs that must satisfy dozens of potentially conflicting situations.

When I first announced that I was going into business for myself with a microcomputer from Radio Shack, I was tactfully asked, "Have you checked with people like IBM or Burroughs?" Somehow, the name Radio Shack doesn't have the authoritative ring of a Honeywell or a Control Data. Apparently, the Tandy Corporation has been worrying about this all the way to the bank. I have great respect for IBM and all the other DP giants, but the computer on the table next to me is a Radio Shack TRS-80. It's the only computer I can afford, and it's done, and is doing, a great job for me.

Summary

The future of custom programming isn't necessarily bright. Right now, custom software fills an obvious need in the microcomputer field. But DP history shows a trend toward standardization - a package for every need right off the shelf. In fact, many other industries display the samd trend. How many people buy custom suits as compared with those buying clothing off the plain pipe racks?

So I'm working on a series of specialized, off-the-shelf programs. In the meantime, as far as user satisfaction is concerned, custom programming is difficult to beat. The customer remains in control - he remains an individual in a growing world of sameness. He may buy his car off the showroom floor, his noon lunch from a franchised restaurant, his very computer from a busy assembly line; but his custom software is distinctively his own. Its operation echoes strong links with his past operation, something with which he can identify. How long the independent small business person will continue to buy this kind of personal identification is a question worthy of feeding into the nearest TRS-80. The answer, of course, depends upon who is doing the programming. □

You create the program to help the person at the terminal in what may be, to him or her, a rather frightening experience.

Spinning Yarns, Relatively Speaking

(a pinwheel poem).

Peter Payack

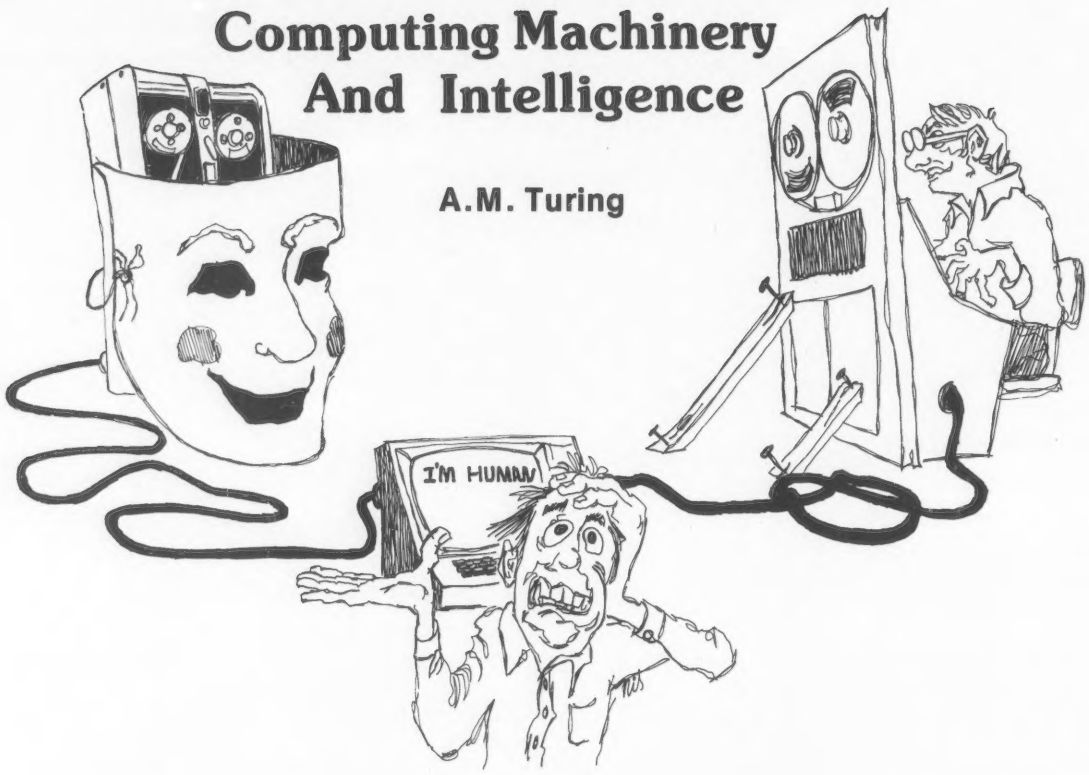
ACCORDING TO EINSTEIN'S THEORY OF RELATIVITY, ANY GIVEN POINT IN SPACE AND TIME CAN BE DECLARED THE CENTER OF THINGS. THE PERIOD AT THE END OF THIS SPINNING POEM IS THE CENTER OF THE UNIVERSE, NOW
CUT ALONG DOTTED LINE

Instructions:

1. Cut out along dotted line.
2. Place a pin through the period in the center of the poem, and then stick it into the eraser of a pencil.
3. Spin while reading.

Computing Machinery And Intelligence

A.M. Turing



Of the early computerists, Alan Turing stands out as a result of his contributions to mathematics, cryptography and artificial intelligence. But today his name is spoken most often in conjunction with "The Turing Test." Here is an historical article which originally appeared in Mind magazine, October 1950 in which Turing first described his famous test. —DHA

1. The Imitation Game

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words "machine" and "think" are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, "Can machines think?" is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

The new form of the problem can be described in terms of a game which we call the "imitation game." It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either "X is A and Y is B" or "X is B and Y is A." The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?

Now suppose X is actually A, then A must answer. It is A's object in the game to try and cause C to make the wrong identification. His answer might therefore be:

"My hair is shingled, and the longest strands are about nine inches long."

In order that tones of voice may not help the interrogator the answers should be written, or better still, typewritten. The ideal arrangement is to have a teleprinter communicating between the two rooms. Alternatively the question and answers can be repeated by an intermediary. The object of the game for the third player (B) is to help the interrogator. The best strategy for her is probably to give truthful answers. She can add such things as "I am the woman, don't listen to him!" to her answers, but it will avail nothing as the man can make similar remarks.

We now ask the question, "What will happen when a machine takes the part of A in this game?" Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman? These questions replace our original, "Can machines think?"

2. Critique of the New Problem

As well as asking, "What is the answer to this new form of the question," one may ask, "Is this new question a worthy one to investigate?" This latter question we investigate without further ado, thereby cutting short an infinite regress.

The new problem has the advantage of drawing a fairly sharp line between the physical and the intellectual capacities of a man. No engineer or chemist claims to be able to produce a material which is indistinguishable from the human skin. It is possible that at some time this might be done, but even supposing this invention available we should feel there was little point in trying to make a "thinking machine" more human by dressing it up in such artificial flesh. The form in which we have set the problem reflects this fact in the condition which prevents the interrogator from seeing or touching the other competitors, or hearing their voices. Some other advantages of the proposed criterion may be shown up by specimen questions and answers. Thus:

Q: Please write me a sonnet on the subject of the Forth Bridge.
A: Count me out on this one. I never could write poetry.
Q: Add 34957 to 70764.
A: (Pause about 30 seconds and then give as answer) 105621.
Q: Do you play chess?
A: Yes.
Q: I have K at my K1, and no other pieces. You have only K at K6 and

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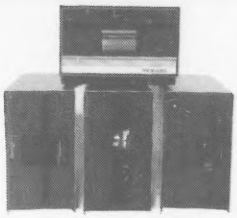

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Machinery, con't . . .

R at R1. It is your move. What do you play?
A: (After a pause of 15 seconds) R-R8 mate.

The question and answer method seems to be suitable for introducing almost any one of the fields of human endeavour that we wish to include. We do not wish to penalise the machine for its inability to shine in beauty competitions, nor to penalise a man for losing in a race against an aeroplane. The conditions of our game make these disabilities irrelevant. The "witnesses" can brag, if they consider it advisable, as much as they please about their charms, strength or heroism, but the interrogator cannot demand practical demonstrations.

The game may perhaps be criticised on the ground that the odds are weighted too heavily against the machine. If the man were to try and pretend to be the machine he would clearly make a very poor showing. He would be given away at once by slowness and inaccuracy in arithmetic. May not machines carry out something which ought to be described as thinking but which is very different from what a man does? This objection is a very strong one, but at least we can say that if, nevertheless, a machine can be constructed to play the imitation game satisfactorily, we need not be troubled by this objection.

It might be urged that when playing the "imitation game" the best strategy for the machine may possibly be something other than imitation of the behaviour of a man. This may be, but I think it is unlikely that there is any great effect of this kind. In any case there is no intention to investigate here the theory of the game, and it will be assumed that the best strategy is to try to provide answers that would naturally be given by a man.

3. The Machines Concerned in the Game

The question which we put in §1 will not be quite definite until we have specified what we mean by the word "machine." It is natural that we should wish to permit every kind of engineering technique to be used in our machines. We also wish to allow the possibility than an engineer or team of engineers may construct a machine which works, but whose manner of operation cannot be satisfactorily described by its constructors because they have applied a method which is largely experimental. Finally, we wish to exclude from the machines men born in the usual manner. It is difficult to frame the definitions so as to satisfy these three conditions. One might for instance insist that the team of engineers should be all of one sex, but this would not really be satisfactory, for it is probably possible to rear a complete individual from a single cell of the skin (say) of a man. To do so would be a feat of biological technique deserving of the very highest praise, but we would not be inclined to regard it as a case of "constructing a thinking machine." This prompts us to abandon the requirement that every kind of technique should be permitted. We are the more ready to do so in view of the fact that the present interest in "thinking machines" has been aroused by a particular kind of machine, usually called an "electronic computer" or "digital computer." Following this suggestion we only permit digital computers to take part in our game.

This restriction appears at first sight to be a very drastic one. I shall attempt to show that it is not so in reality. To do this necessitates a short account of the nature and properties of these computers.

It may also be said that this identification of machines with digital computers, like our criterion for "thinking," will only be unsatisfactory if (contrary to my belief), it turns out that digital computers are unable to give a good showing in the game.

There are already a number of digital computers in working order, and it may be asked, "Why not try the experiment straight away? It would be easy to satisfy the conditions of the game. A number of interrogators could be used, and statistics compiled to show how often the right identification was given." The short answer is that we are not asking whether all digital computers would do well in the game nor whether the computers at present available would do well, but whether there are imaginable computers which would do well. But this is only the short answer. We shall see this question in a different light later.

4. Digital Computers

The idea behind digital computers may be explained by saying that these machines are intended to carry out any operations which could be done by a human computer. The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail. We may suppose that these rules are supplied in a book, which is altered whenever he is put on to a new job. He has also an unlimited supply of paper on which he does his calculations. He may also do his multiplications and additions on a "desk machine," but this is not important.

If we use the above explanation as a definition we shall be in danger of circularity of argument. We avoid this by giving an outline of the means by which the desired effect is achieved. A digital computer can usually be regarded as consisting of three parts:

(i) Store.
(ii) Executive unit.
(iii) Control.

The store is a store of information, and corresponds to the human computer's paper, whether this is the paper on which he does his calculations or that on which his book of rules is printed. In so far as the human computer does calculations in his head a part of the store will correspond to his memory.

The executive unit is the part which carries out the various individual operations involved in a calculation. What these individual operations are will vary from machine to machine. Usually fairly lengthy operations can be done such as "Multiply 3540675445 by 7076345687" but in some machines only very simple ones such as "Write down 0" are possible.

We have mentioned that the "book of rules" supplied to the computer is replaced in the machine by a part of the store. It is then called the "table of instructions." It is the duty of the control to see that these instructions are obeyed correctly and in the right order. The control is so constructed that this necessarily happens.

The information in the store is usually broken up into packets of moderately small size. In one machine, for instance, a packet might consist of ten decimal digits. Numbers are assigned to the parts of the store in which the various packets of information are stored, in some systematic manner. A typical instruction might say—

"Add the number stored in position 6809 to that in 4302 and put the result back into the latter storage position."

Needless to say it would not occur in the machine expressed in English. It would more likely be coded in a form such as 6809430217. Here 17 says which of various possible operations is to be performed on the two numbers. In this case the operation is that described above, *viz.*, "Add the number. . . ." It will be noticed that the instruction takes up 10 digits and so forms one packet of information, very conveniently. The control will normally take the instructions to be obeyed in the order of the positions in which they are stored, but occasionally an instruction such as

"Now obey the instruction stored in position 5606, and continue from there"

may be encountered, or again

"If position 4505 contains 0 obey next the instruction stored in 6707, otherwise continue straight on."

Instructions of these latter types are very important because they make it possible for a sequence of operations to be replaced over and over again until some condition is fulfilled, but in doing so to obey, not fresh instructions on each repetition, but the same ones over and over again. To take a domestic analogy. Suppose Mother wants Tommy to call at the cobbler's every morning on his way to school to see if her shoes are done, she can ask him afresh every morning. Alternatively she can stick up a notice once and for all in the hall which he will see when he leaves for school and which tells him to call for the shoes, and also to destroy the notice when he comes back if he has the shoes with him.

The reader must accept it as a fact that digital computers can be constructed, and indeed have been constructed, according to the principles we have described, and that they can in fact mimic the actions of a human computer very closely.

The book of rules which we have described our human computer as using is of course a convenient fiction. Actual human computers really remember what they have got to do. If one wants to make a machine mimic the behaviour of the human computer in some complex operation one has to ask him how it is done, and then translate the answer into the form of an instruction table. Constructing instruction tables is usually described as "programming." To "programme a machine to carry out the operation A" means to put the appropriate instruction table into the machine so that it will do A.

An interesting variant on the idea of a digital computer is a "digital computer with a random element." These have instructions involving the throwing of a die or some equivalent electronic process; one such instruction might for instance be, "Throw the die and put the resulting number into store 1000." Sometimes such a machine is described as having free will (though I would not use this phrase myself). It is not normally possible to determine from observing a machine whether it has a random ele-

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ment, for a similar effect can be produced by such devices as making the choices depend on the digits of the decimal for π.

Most actual digital computers have only a finite store. There is no theoretical difficulty in the idea of a computer with an unlimited store. Of course only a finite part can have been used at any one time. Likewise only a finite amount can have been constructed, but we can imagine more and more being added as required. Such computers have special theoretical interest and will be called infinitive capacity computers.

The idea of a digital computer is an old one. Charles Babbage, Lucasian Professor of Mathematics at Cambridge from 1828 to 1839, planned such a machine, called the Analytical Engine, but it was never completed. Although Babbage had all the essential ideas, his machine was not at that time such a very attractive prospect. The speed which would have been available would be definitely faster than a human computer but something like 100 times slower than the Manchester machine, itself one of the slower of the modern machines. The storage was to be purely mechanical, using wheels and cards.

The fact that Babbage's Analytical Engine was to be entirely mechanical will help us to rid ourselves of a superstition. Importance is often attached to the fact that modern digital computers are electrical, and that the nervous system also is electrical. Since Babbage's machine was not electrical, and since all digital computers are in a sense equivalent, we see that this use of electricity cannot be of theoretical importance. Of course electricity usually comes in where fast signalling is concerned, so that it is not surprising that we find it in both these connections. In the nervous system chemical phenomena are at least as important as electrical. In certain computers the storage system is mainly acoustic. The feature of using electricity is thus seen to be only a very superficial similarity. If we wish to find such similarities we should look rather for mathematical analogies of function.

5. *Universality of Digital Computers*

The digital computers considered in the last section may be classified amongst the "discrete-state machines." These are the machines which move by sudden jumps or clicks from one quite definite state to another. These states are sufficiently different for the possibility of confusion between them to be ignored. Strictly speaking there are no such machines. Everything really moves continuously. But there are many kinds of machine which can profitably be *thought of* as being discrete-state machines. For instance in considering the switches for a lighting system it is a convenient fiction that each switch must be definitely on or definitely off. There must be intermediate positions, but for most purposes we can forget about them. As an example of a discrete-state machine we might consider a wheel which clicks round through 120° once a second, but may be stopped by a lever which can be operated from outside; in addition a lamp is to light in one of the positions of the wheel. This machine could be described abstractly as follows. The internal state of the machine (which is described by the position of the wheel) may be q_1, q_2 or q_3. There is an input signal i_0 or i_1 (position of lever). The internal state at any moment is determined by the last state and input signal according to the table

		Last State		
		q_1	q_2	q_3
Input	i_0	q_2	q_3	q_1
	i_1	q_1	q_2	q_3

The output signals, the only externally visible indication of the internal state (the light) are described by the table

State	q_1	q_2	q_3
Output	o_0	o_0	o_1

This example is typical of discrete-state machines. They can be described by such tables provided they have only a finite number of possible states.

It will seem that given the initial state of the machine and the input signals it is always possible to predict all future states. This is reminiscent of Laplace's view that from the complete state of the universe at one moment of time, as described by the positions and velocities of all particles, it should be possible to predict all future states. The prediction which we are considering is, however, rather nearer to practicability than that considered by Laplace. The system of the "universe as a whole" is such that quite small errors in the initial conditions can have an overwhelming effect at a later time. The displacement of a single electron by a billionth of a centimetre at one moment might make the difference between a man being killed by an avalanche a year later, or escaping. It is an essential property of the mechanical systems which we have called "discrete-state machines" that this phenomenon does not occur. Even when we consider the actual physical machines instead of the idealised machines, reasonably accurate knowledge of the state at one moment yields reasonably accurate knowledge any number of steps later.

As we have mentioned, digital computers fall within the class of discrete-state machines. But the number of states of which such a machine is capable is usually enormously large. For instance, the number for the machine now working at Manchester is about $2^{165,000}$, *i.e.*, about $10^{50,000}$. Compare this with our example of the clicking wheel described above, which had three states. It is not difficult to see why the number of states should be so immense. The computer includes a store corresponding to the paper used by a human computer. It must be possible to write into the store any one of the combinations of symbols which might have been written on the paper. For simplicity suppose that only digits from 0 to 9 are used as symbols. Variations in handwriting are ignored. Suppose the computer is allowed 100 sheets of paper each containing 50 lines each with room for 30 digits. Then the number of states is $10^{100 \times 50 \times 30}$, *i.e.*, $10^{150,000}$. This is about the number of states of three Manchester machines put together. The logarithm to the base two of the number of states is usually called the "storage capacity" of the machine. Thus the Manchester machine has a storage capacity of about 165,000 and the wheel machine of our example about 1.6. If two machines are put together their capacities must be added to obtain the capacity of the resultant machine. This leads to the possibility of statements such as "The Manchester machine contains 64 magnetic tracks each with a capacity of 2560, eight electronic tubes with a capacity of 1280. Miscellaneous storage amounts to about 300 making a total of 174,380."

Given the table corresponding to a discrete-state machine it is possible to predict what it will do. There is no reason why this calculation should not be carried out by means of a digital computer. Provided it could be carried out sufficiently quickly the digital computer could mimic the behavior of any discrete-state machine. The imitation game could then be played with the machine in question (as B) and the mimicking digital computer (as A) and the interrogator would be unable to distinguish them. Of course the digital computer must have an adequate storage capacity as well as working sufficiently fast. Moreover, it must be programmed afresh for each new machine which it is desired to mimic.

This special property of digital computers, that they can mimic any discrete-state machine, is described by saying that they are *universal* machines. The existence of machines with this property has the important consequence that, considerations of speed apart, it is unnecessary to design various new machines to do various computing processes. They can all be done with one digital computer, suitably programmed for each case. It will be seen that as a consequence of this all digital computers are in a sense equivalent.

We may now consider again the point raised at the end of §3. It was suggested tentatively that the question, "Can machines think?" should be replaced by "Are there imaginable digital computers which would do well in the imitation game?" If we wish we can make this superficially more general and ask "Are there discrete-state machines which would do well?" But in view of the universality property we see that either of these questions is equivalent to this, "Let us fix our attention on one particular digital computer *C*. Is it true that by modifying this computer to have an adequate storage, suitably increasing its speed of action, and providing it with an appropriate programme, *C* can be made to play satisfactorily the part of A in the imitation game, the part of B being taken by a man?"

6. *Contrary Views on the Main Question*

We may now consider the ground to have been cleared and we are ready to proceed to the debate on our question, "Can machines think?" and the variant of it quoted at the end of the last section. We cannot altogether abandon the original form of the problem, for opinions will differ as to the appropriateness of the substitution and we must at least listen to what has to be said in this connexion.

It will simplify matters for the reader if I explain first my own beliefs in the matter. Consider first the more accurate form of the question. I believe that in about fifty years' time it will be possible to programme computers, with a storage capacity of about 10^9, to make them play the imitation game so well that an average interrogator will not have more than 70 per cent chance of making the right identification after five minutes of questioning. The original question, "Can machines think?" I believe to be too meaningless to deserve discussion. Nevertheless I believe that at the end of the

century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted. I believe further that no useful purpose is served by concealing these beliefs. The popular view that scientists proceed inexorably from well-established fact to well-established fact, never being influenced by any improved conjecture, is quite mistaken. Provided it is made clear which are proved facts and which are conjectures, no harm can result. Conjectures are of great importance since they suggest useful lines of research.

I now proceed to consider opinions opposed to my own.

(1) The Theological Objection

Thinking is a function of man's immortal soul. God has given an immortal soul to every man and woman, but not to any other animal or to machines. Hence no animal or machine can think.[1]

I am unable to accept any part of this, but will attempt to reply in theological terms. I should find the argument more convincing if animals were classed with men, for there is a greater difference, to my mind, between the typical animate and the inanimate than there is between man and the other animals. The arbitrary character of the orthodox view becomes clearer if we consider how it might appear to a member of some other religious community. How do Christians regard the Moslem view that women have no souls? But let us leave this point aside and return to the main argument. It appears to me that the argument quoted above implies a serious restriction of the omnipotence of the Almighty. It is admitted that there are certain things that He cannot do such as making one equal to two, but should we not believe that He has freedom to confer a soul on an elephant if He sees fit? We might expect that He would only exercise this power in conjunction with a mutation which provided the elephant with an appropriately improved brain to minister to the needs of this soul. An argument of exactly similar form may be made for the case of machines. It may seem different because it is more difficult to "swallow." But this really only means that we think it would be less likely that He would consider the circumstances suitable for conferring a soul. The circumstances in question are discussed in the rest of this paper. In attempting to construct such machines we should not be irreverently usurping His power of creating souls, any more than we are in the procreation of children: rather we are, in either case, instruments of His will providing mansions for the souls that He creates.

However, this is mere speculation. I am not very impressed with theological arguments whatever they may be used to support. Such arguments have often been found unsatisfactory in the past. In the time of Galileo it was argued that the texts, "And the sun stood still . . . and hasted not to go down about a whole day" (Joshua x. 13) and "He laid the foundations of the earth, that it should not move at any time" (Psalm cv. 5) were an adequate refutation of the Copernican theory. With our present knowledge such an argument appears futile. When that knowledge was not available it made a quite different impression.

(2) The "Heads in the Sand" Objection

"The consequences of machines thinking would be too dreadful. Let us hope and believe that they cannot do so."

This argument is seldom expressed quite so openly as in the form above. But it affects most of us who think about it at all. We like to believe that Man is in some subtle way superior to the rest of creation. It is best if he can be shown to be *necessarily* superior, for then there is no danger of him losing his commanding position. The popularity of the theological argument is clearly connected with this feeling. It is likely to be quite strong in intellectual people, since they value the power of thinking more highly than others, and are more inclined to base their belief in the superiority of Man on this power.

I do not think that this argument is sufficiently substantial to require refutation. Consolation would be more appropriate: perhaps this should be sought in the transmigration of souls.

(3) The Mathematical Objection

There are a number of results of mathematical logic which can be used to show that there are limitations to the powers of discrete-state machines. The best known of these results is known as Gödel's theorem (1931) and shows that in any sufficiently powerful logical system statements can be formulated which can neither be proved nor disproved within the system, unless possibly the system itself is inconsistent. There are other, in some respects similar, results due to Church (1936), Kleene (1935), Rosser, and Turing (1937). The latter result is the most convenient to consider, since it refers directly to machines, whereas the others can only be used in a comparatively indirect argument: for instance if Gödel's theorem is to be used we need in addition to have some means of describing logical systems in terms of machines, and machines in terms of logical systems. The result in question refers to a type of machine which is essentially a digital computer with an infinite capacity. It states that there are certain things that such a machine cannot do. If it is rigged up to give answers to questions as in the imitation game, there will be some questions to which it will either give a wrong answer, or fail to give an answer at all however much time is allowed for a reply. There may, of course, be many such questions, and questions which cannot be answered by one machine may be satisfactorily answered by another. We are of course supposing for the present that the questions are of the kind to which an answer "Yes" or "No" is appropriate, rather than questions such as "What do you think of Picasso?" The questions that we know the machines must fail on are of this type, "Consider the machine specified as follows. . . . Will this machine ever answer 'Yes' to any question?" The dots are to be replaced by a description of some machine in a standard form, which could be something like that used in §5. When the machine described bears a certain comparatively simple relation to the machine which is under interrogation, it can be shown that the answer is either wrong or not forthcoming. This is the mathematical result: it is argued that it proves a disability of machines to which the human intellect is not subject.

The short answer to this argument is that although it is established that there are limitations to the powers of any particular machine, it has only been stated, without any sort of proof, that no such limitations apply to the human intellect. But I do not think this view can be dismissed quite so lightly. Whenever one of these machines is asked the appropriate critical question, and gives a definite answer, we know that this answer must be wrong, and this gives us a certain feeling of superiority. Is this feeling illusory? It is no doubt quite genuine, but I do not think too much importance should be attached to it. We too often give wrong answers to questions ourselves to be justified in being very pleased at such evidence of fallibility on the part of the machines. Further, our superiority can only be felt on such an occasion in relation to the one machine over which we have scored our petty triumph. There would be no question of triumphing simultaneously over *all* machines. In short, then, there might be men cleverer than any given machine, but then again there might be other machines cleverer again, and so on.

Those who hold to the mathematical argument would, I think, mostly be willing to accept the imitation game as a basis for discussion. Those who believe in the two previous objections would probably not be interested in any criteria.

(4) The Argument from Consciousness

This argument is very well expressed in Professor Jefferson's Lister Oration for 1949, from which I quote. "Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain—that is, not only write it but know that it had written it. No mechanism could feel (and not merely artificially signal, an easy contrivance) pleasure at its successes, grief when its valves fuse, be warmed by flattery, be made miserable by its mistakes, be charmed by sex, be angry or depressed when it cannot get what it wants."

This argument appears to be a denial of the validity of our test. According to the most extreme form of this view the only way by which one could be sure that a machine thinks is to *be* the machine and to feel oneself thinking. One could then describe these feelings to the world, but of course no one would be justified in taking any notice. Likewise according to this view the only way to know that a *man* thinks is to be that particular man. It is in fact the solipsist point of view. It may be the most logical view to hold but it makes communication of ideas difficult. A is liable to believe "A thinks but B does not" whilst B believes "B thinks but A does not." Instead of arguing continually over this point it is usual to have the polite convention that everyone thinks.

I am sure that Professor Jefferson does not wish to adopt the extreme and solipsist point of view. Probably he would be quite willing to accept the imitation game as a test. The game (with the player B omitted) is frequently used in practice under the name of *viva voce* to discover whether some one really understands something or has "learnt it parrot fashion." Let us listen in to a part of such a *viva voce*:

[1] Possibly this view is heretical. St. Thomas Aquinas [*Summa Theologica*, quoted by Bertrand Russell (1945, p. 458)] states that God cannot make a man to have no soul. But this may not be a real restriction on His powers, but only a result of the fact that men's souls are immortal, and therefore indestructible.

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Interrogator: In the first line of your sonnet which reads "Shall I compare thee to a summer's day," would not "a spring day" do as well or better?
Witness: It wouldn't scan.
Interrogator: How about "a winter's day." That would scan all right.
Witness: Yes, but nobody wants to be compared to a winter's day.
Interrogator: Would you say Mr. Pickwick reminded you of Christmas?
Witness: In a way.
Interrogator: Yet Chrismas is a winter's day, and I do not think Mr. Pickwick would mind the comparison.
Witness: I don't think you're serious. By a winter's day one means a typical winter's day, rather than a special one like Christmas.

And so on. What would Professor Jefferson say if the sonnet-writing machine was able to answer like this in the *viva voce*? I do not know whether he would regard the machine as "merely artificially signalling" these answers, but if the answers were as satisfactory and sustained as in the above passage I do not think he would describe it as "an easy contrivance." This phrase is, I think, intended to cover such devices as the inclusion in the machine of a record of someone reading a sonnet, with appropriate switching to turn it on from time to time.

In short then, I think that most of those who support the argument from consciousness could be persuaded to abandon it rather than be forced into the solipsist position. They will then probably be willing to accept our test.

I do not wish to give the impression that I think there is no mystery about consciousness. There is, for instance, something of a paradox connected with any attempt to localise it. But I do not think these mysteries necessarily need to be solved before we can answer the question with which we are concerned in this paper.

(5) Arguments from Various Disabilities

These arguments take the form, "I grant you that you can make machines do all the things you have mentioned but you will never be able to make one to do X." Numerous features X are suggested in this connexion. I offer a selection:

Be kind, resourceful, beautiful, friendly, have initiative, have a sense of humour, tell right from wrong, make mistakes, fall in love, enjoy strawberries and cream, make some one fall in love with it, learn from experience, use words properly, be the subject of its own thought, have as much diversity of behaviour as a man, do something really new.

No support is usually offered for these statements. I believe they are mostly founded on the principle of scientific induction. A man has seen thousands of machines in his lifetime. From what he sees of them he draws a number of general conclusions. They are ugly, each is designed for a very limited purpose, when required for a minutely different purpose they are useless, the variety of behaviour of any one of them is very small, etc., etc. Naturally he concludes that these are necessary properties of machines in general. Many of these limitations are associated with the very small storage capacity of most machines. (I am assuming that the idea of storage capacity is extended in some way to cover machines other than discrete-state machines. The exact definition does not matter as no mathematical accuracy is claimed in the present discussion.) A few years ago, when very little had been heard of digital computers, it was possible to elicit much incredulity concerning them, if one mentioned their properties without describing their construction. That was presumably due to a similar application of the principle of scientific induction. These applications of the principle are of course largely unconscious. When a burnt child fears the fire and shows that he fears it by avoiding it, I should say that he was applying scientific induction. (I could of course also describe his behaviour in many other ways.) The works and customs of mankind do not seem to be very suitable material to which to apply scientific induction. A very large part of space-time must be investigated, if reliable results are to be obtained. Otherwise we may (as most English children do) decide that everybody speaks English, and that it is silly to learn French.

There are, however, special remarks to be made about many of the disabilities that have been mentioned. The inability to enjoy strawberries and cream may have struck the reader as frivolous. Possibly a machine might be made to enjoy this delicious dish, but any attempt to make one do so would be idiotic. What is important about this disability is that it contributes to some of the other disabilities, *e.g.*, to the difficulty of the same kind of friendliness occurring between man and machine as between white man and white man, or between black man and black man.

The claim that "machines cannot make mistakes" seems a curious one. One is tempted to retort, "Are they any the worse for that?" But let us adopt a more sympathetic attitude, and try to see what is really meant. I think this criticism can be explained in terms of the imitation game. It is claimed that the interrogator could distinguish the machine from the man simply by setting them a number of problems in arithmetic. The machine would be unmasked because of its deadly accuracy. The reply to this is simple. The machine (programmed for playing the game) would not attempt to give the *right* answers to the arithmetic problems. It would deliberately introduce mistakes in a manner calculated to confuse the interrogator. A mechanical fault would probably show itself through an unsuitable decision as to what sort of a mistake to make in the arithmetic. Even this interpretation of the criticism is not sufficiently sympathetic. But we cannot afford the space to go into it much further. It seems to me that this criticism depends on a confusion between two kinds of mistake. We may call them "errors of functioning" and "errors of conclusion." Errors of functioning are due to some mechanical or electrical fault which causes the machine to behave otherwise than it was designed to do. In philosophical discussions one likes to ignore the possibility of such errors; one is therefore discussing "abstract machines." These abstract machines are mathematical fictions rather than physical objects. By definition they are incapable of errors of functioning. In this sense we can truly say that "machines can never make mistakes." Errors of conclusion can only arise when some meaning is attached to the output signals from the machine. The machine might, for instance, type out mathematical equations, or sentences in English. When a false proposition is typed we say that the machine has committed an error of conclusion. There is clearly no reason at all for saying that a machine cannot make this kind of mistake. It might do nothing but type out repeatedly "0 = 1." To take a less perverse example, it might have some method for drawing conclusions by scientific induction. We must expect such a method to lead occasionally to erroneous results.

The claim that a machine cannot be the subject of its own thought can of course only be answered if it can be shown that the machine has *some* thought with *some* subject matter. Nevertheless, "the subject matter of a machine's operations" does seem to mean something, at least to the people who deal with it. If, for instance, the machine was trying to find a solution of the equation $x^2 - 40x - 11 = 0$ one would be tempted to describe this equation as part of the machine's subject matter at that moment. In this sort of sense a machine undoubtedly can be its own subject matter. It may be used to help in making up its own programmes, or to predict the effect of alterations in its own structure. By observing the results of its own behaviour it can modify its own programmes so as to achieve some purpose more effectively. These are possibilities of the near future, rather than Utopian dreams.

The criticism that a machine cannot have much diversity of behaviour is just a way of saying that it cannot have much storage capacity. Until fairly recently a storage capacity of even a thousand digits was very rare.

The criticisms that we are considering here are often disguised forms of the argument from consciousness. Usually if one maintains that a machine *can* do one of these things, and describes the kind of method that the machine could use, one will not make much of an impression. It is thought that the method (whatever it may be, for it must be mechanical) is really rather base. Compare the parentheses in Jefferson's statement quoted on page 49.

(6) Lady Lovelace's Objection

Our most detailed information of Babbage's Analytical Engine comes from a memoir by Lady Lovelace (1842). In it she states, "The Analytical Engine has no pretensions to *originate* anything. It can do *whatever we know how to order it* to perform" (her italics). This statement is quoted by Hartree (1949) who adds: "This does not imply that it may not be possible to construct electronic equipment which will 'think for itself,' or in which, in biological terms, one could set up a conditioned reflex, which would serve as a basis for 'learning.' Whether this is possible in principle or not is a stimulating and exciting question, suggested by some of these recent developments. But it did not seem that the machines constructed or projected at the time had this property."

I am in thorough agreement with Hartree over this. It will be noticed that he does not assert that the machines in question had not got the property, but rather that the evidence available to Lady Lovelace did not encourage her to believe that they had it. It is quite possible that the machines in question had in a sense got this property. For suppose that some discrete-state machine has the property. The Analytical Engine was a universal digital computer, so that, if its storage capacity and speed were adequate, it could by suitable programming be made to mimic the machine in question. Probably this argument did not occur to the Countess or to Babbage. In any case there was no obligation on them to claim all that could be claimed.

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This whole question will be considered again under the heading of learning machines.

A variant of Lady Lovelace's objection states that a machine can "never do anything really new." This may be parried for a moment with the saw, "There is nothing new under the sun." Who can be certain that "original work" that he has done was not simply the growth of the seed planted in him by teaching, or the effect of following well-known general principles. A better variant of the objection says that a machine can never "take us by surprise." This statement is a more direct challenge and can be met directly. Machines take me by surprise with great frequency. This is largely because I do not do sufficient calculation to decide what to expect them to do, or rather because, although I do a calculation, I do it in a hurried, slipshod fashion, taking risks. Perhaps I say to myself, "I suppose the voltage here ought to be the same as there: anyway let's assume it is." Naturally I am often wrong, and the result is a surprise for me for by the time the experiment is done these assumptions have been forgotten. These admissions lay me open to lectures on the subject of my vicious ways, but do not throw any doubt on my credibility when I testify to the surprises I experience.

I do not expect this reply to silence my critic. He will probably say that such surprises are due to some creative mental act on my part, and reflect no credit on the machine. This leads us back to the argument from consciousness, and far from the idea of surprise. It is a line of argument we must consider closed, but it is perhaps worth remarking that the appreciation of something as surprising requires as much of a "creative mental act" whether the surprising event originates from a man, a book, a machine or anything else.

The view that machines cannot give rise to surprises is due, I believe, to a fallacy to which philosophers and mathematicians are particularly subject. This is the assumption that as soon as a fact is presented to a mind all consequences of that fact spring into the mind simultaneously with it. It is a very useful assumption under many circumstances, but one too easily forgets that it is false. A natural consequence of doing so is that one then assumes that there is no virtue in the mere working out of consequences from data and general principles.

(7) Argument from Continuity in the Nervous System

The nervous system is certainly not a discrete-state machine. A small error in the information about the size of a nervous impulse impinging on a neuron, may make a large difference to the size of the outgoing impulse. It may be argued that, this being so, one cannot expect to be able to mimic the behaviour of the nervous system with a discrete-state system.

It is true that a discrete-state machine must be different from a continuous machine. But if we adhere to the conditions of the imitation game, the interrogator will not be able to take any advantage of this difference. The situation can be made clearer if we consider some other simpler continuous machine. A differential analyser will do very well. (A differential analyser is a certain kind of machine not of the discrete-state type used for some kinds of calculation.) Some of these provide their answers in a typed form, and so are suitable for taking part in the game. It would not be possible for a digital computer to predict exactly what answers the differential analyser would give to a problem, but it would be quite capable of giving the right sort of answer. For instance, if asked to give the value of π (actually about 3.1416) it would be reasonable to choose at random between the values 3.12, 3.13, 3.14, 3.15, 3.16 with the probabilities of 0.05, 0.15, 0.55, 0.19, 0.06 (say). Under these circumstances it would be very difficult for the interrogator to distinguish the differential analyser from the digital computer.

(8) The Argument from Informality of Behaviour

It is not possible to produce a set of rules purporting to describe what a man should do in every conceivable set of circumstances. One might for instance have a rule that one is to stop when one sees a red traffic light, and to go if one sees a green one, but what if by some fault both appear together? One may perhaps decide that it is safest to stop. But some further difficulty may well arise from this decision later. To attempt to provide rules of conduct to cover every eventuality, even those arising from traffic lights, appears to be impossible. With all this I agree.

From this it is argued that we cannot be machines. I shall try to reproduce the argument, but I fear I shall hardly do it justice. It seems to run something like this. "If each man had a definite set of rules of conduct by which he regulated his life he would be no better than a machine. But there are no such rules, so men cannot be machines." The undistributed middle is glaring. I do not think the argument is ever put quite like this, but I believe this is the argument used nevertheless. There may however be a certain confusion between "rules of conduct" and "laws of behaviour" to cloud the issue. By "rules of conduct" I mean precepts such as "Stop if you see red lights," on which one can act, and of which one can be conscious. By "laws of behaviour" I mean laws of nature as applied to a man's body such as "if you pinch him he will squeak." If we substitute "laws of behaviour which regulate his life" for "laws of conduct by which he regulates his life" in the argument quoted the undistributed middle is no longer insuperable. For we believe that it is not only true that being regulated by laws of behaviour implies being some sort of machine (though not necessarily a discrete-state machine), but that conversely being such a machine implies being regulated by such laws. However, we cannot so easily convince ourselves of the absence of complete laws of behaviour as of complete rules of conduct. The only way we know of for finding such laws is scientific observation, and we certainly know of no circumstances under which we could say, "We have searched enough. There are no such laws."

We can demonstrate more forcibly that any such statement would be unjustified. For suppose we could be sure of finding such laws if they existed. Then given a discrete-state machine it should certainly be possible to discover by observation sufficient about it to predict its future behaviour, and this within a reasonable time, say a thousand years. But this does not seem to be the case. I have set up on the Manchester computer a small programme using only 1,000 units of storage, whereby the machine supplied with one sixteen-figure number replies with another within two seconds. I would defy anyone to learn from these replies sufficient about the programme to be able to predict any replies to untried values.

(9) The Argument from Extrasensory Perception

I assume that the reader is familiar with the idea of extrasensory perception, and the meaning of the four items of it, *viz.*, telepathy, clairvoyance, precognition and psychokinesis. These disturbing phenomena seem to deny all our usual scientific ideas. How we should like to discredit them! Unfortunately the statistical evidence, at least for telepathy, is overwhelming. It is very difficult to rearrange one's ideas so as to fit these new facts in. Once one has accepted them it does not seem a very big step to believe in ghosts and bogies. The idea that our bodies move simply according to the known laws of physics, together with some others not yet discovered but somewhat similar, would be one of the first to go.

This argument is to my mind quite a strong one. One can say in reply that many scientific theories seem to remain workable in practice, in spite of clashing with ESP; that in fact one can get along very nicely if one forgets about it. This is rather cold comfort, and one fears that thinking is just the kind of phenomenon where ESP may be especially relevant.

A more specific argument based on ESP might run as follows: "Let us play the imitation game, using as witnesses a man who is good as a telepathic receiver, and a digital computer. The interrogator can ask such questions as 'What suit does the card in my right hand belong to?' The man by telepathy or clairvoyance gives the right answer 130 times out of 400 cards. The machine can only guess at random, and perhaps gets 104 right, so the interrogator makes the right identification." There is an interesting possibility which opens here. Suppose the digital computer contains a random number generator. Then it will be natural to use this to decide what answer to give. But then the random number generator will be subject to the psychokinetic powers of the interrogator. Perhaps this psychokinesis might cause the machine to guess right more often than would be expected on a probability calculation, so that the interrogator might still be unable to make the right identification. On the other hand, he might be able to guess right without any questioning, by clairvoyance. With ESP anything may happen.

If telepathy is admitted it will be necessary to tighten our test up. The situation could be regarded as analogous to that which would occur if the interrogator were talking to himself and one of the competitors was listening with his ear to the wall. To put the competitors into a "telepathy-proof room" would satisfy all requirements.

7. Learning Machines

The reader will have anticipated that I have no very convincing arguments of a positive nature to support my views. If I had I should not have taken such pains to point out the fallacies in contrary views. Such evidence as I have I shall now give.

Let us return for a moment to Lady Lovelace's objection, which stated that the machine can only do what we tell it to do. One could say that a man can "inject" an idea into the machine, and that it will respond to a certain extent and then drop into quiescence, like a piano string struck by a hammer. Another simile would be an atomic pile of less than critical

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size: an injected idea is to correspond to a neutron entering the pile from without. Each such neutron will cause a certain disturbance which eventually dies away. If, however, the size of the pile is sufficiently increased, the disturbance caused by such an incoming neutron will very likely go on and on increasing until the whole pile is destroyed. Is there a corresponding phenomenon for minds, and is there one for machines? There does seem to be one for the human mind. The majority of them seem to be "subcritical," *i.e.*, to correspond in this analogy to piles of subcritical size. An idea presented to such a mind will on average give rise to less than one idea in reply. A smallish proportion are supercritical. An idea presented to such a mind that may give rise to a whole "theory" consisting of secondary, tertiary and more remote ideas. Animals minds seem to be very definitely subcritical. Adhering to this analogy we ask, "Can a machine be made to be supercritical?"

The "skin-of-an-onion" analogy is also helpful. In considering the functions of the mind or the brain we find certain operations which we can explain in purely mechanical terms. This we say does not correspond to the real mind: it is a sort of skin which we must strip off if we are to find the real mind. But then in what remains we find a further skin to be stripped off, and so on. Proceeding in this way do we ever come to the "real" mind, or do we eventually come to the skin which has nothing in it? In the latter case the whole mind is mechanical. (It would not be a discrete-state machine however. We have discussed this.)

These last two paragraphs do not claim to be convincing arguments. They should rather be described as "recitations tending to produce belief."

The only really satisfactory support that can be given for the view expressed at the beginning of §6, will be that provided by waiting for the end of the century and then doing the experiment described. But what can we say in the meantime? What steps should be taken now if the experiment is to be successful?

As I have explained, the problem is mainly one of programming. Advances in engineering will have to be made too, but it seems unlikely that these will not be adequate for the requirements. Estimates of the storage capacity of the brain vary from 10^{10} to 10^{15} binary digits. I incline to the lower values and believe that only a very small fraction is used for the higher types of thinking. Most of it is probably used for the retention of visual impressions. I should be surprised if more than 10^9 was required for satisfactory playing of the imitation game, at any rate against a blind man. (*Note:* The capacity of the *Encyclopaedia Britannica,* 11th edition, is 2×10^9.) A storage capacity of 10^7 would be a very practicable possibility even by present techniques. It is probably not necessary to increase the speed of operations of the machines at all. Parts of modern machines which can be regarded as analogs of nerve cells work about a thousand times faster than the latter. This should provide a "margin of safety" which could cover losses of speed arising in many ways. Our problem then is to find out how to programme these machines to play the game. At my present rate of working I produce about a thousand digits of programme a day, so that about sixty workers, working steadily through the fifty years might accomplish the job, if nothing went into the wastepaper basket. Some more expeditious method seems desirable.

In the process of trying to imitate an adult human mind we are bound to think a good deal about the process which has brought it to the state that it is in. We may notice three components.

(*a*) The initial state of the mind, say at birth,
(*b*) The education to which it has been subjected,
(*c*) Other experience, not to be described as education, to which it has been subjected.

Instead of trying to produce a programme to simulate the adult mind, why not rather try to produce one which simulates the child's? If this were then subjected to an appropriate course of education one would obtain the adult brain. Presumably the child brain is something like a notebook as one buys it from the stationer's. Rather little mechanism, and lots of blank sheets. (Mechanism and writing are from our point of view almost synonymous.) Our hope is that there is so little mechanism in the child brain that something like it can be easily programmed. The amount of work in the education we can assume, as a first approximation, to be much the same as for the human child.

We have thus divided our problem into two parts. The child programme and the education process. These two remain very closely connected. We cannot expect to find a good child machine at the first attempt. One must experiment with teaching one such machine and see how well it learns. One can then try another and see if it is better or worse. There is an obvious connection between this process and evolution, by the identifications

Structure of the child machine = hereditary material
Changes of the child machine = mutations
Natural selection = judgment of the experimenter

One may hope, however, that this process will be more expeditious than evolution. The survival of the fittest is a slow method for measuring advantages. The experimenter, by the exercise of intelligence, should be able to speed it up. Equally important is the fact that he is not restricted to random mutations. If he can trace a cause for some weakness he can probably think of the kind of mutation which will improve it.

It will not be possible to apply exactly the same teaching process to the machine as to a normal child. It will not, for instance, be provided with legs, so that it could not be asked to go out and fill the coal scuttle. Possibly it might not have eyes. But however well these deficiencies might be overcome by clever engineering, one could not send the creature to school without the other children making excessive fun of it. It must be given some tuition. We need not be too concerned about the legs, eyes, etc. The example of Miss Helen Keller shows that education can take place provided that communication in both directions between teacher and pupil can take place by some means or other.

We normally associate punishments and rewards with the teaching process. Some simple child machines can be constructed or programmed on this sort of principle. The machine has to be so constructed that events which shortly preceded the occurrence of a punishment signal are unlikely to be repeated, whereas a reward signal increased the probability of repetition of the events which led up to it. These definitions do not presuppose any feelings on the part of the machine. I have done some experiments with one such child machine, and succeeded in teaching it a few things, but the teaching method was too unorthodox for the experiment to be considered really successful.

The use of punishments and rewards can at best be a part of the teaching process. Roughly speaking, if the teacher has no other means of communicating to the pupil, the amount of information which can reach him does not exceed the total number of rewards and punishments applied. By the time a child has learnt to repeat "Casabianca" he would probably feel very sore indeed, if the text could only be discovered by a "Twenty Questions" technique, every "NO" taking the form of a blow. It is necessary therefore to have some other "unemotional" channels of communication. If these are available it is possible to teach a machine by punishments and rewards to obey orders given in some language, *e.g.*, a symbolic language. These orders are to be transmitted through the "unemotional" channels. The use of this language will diminish greatly the number of punishments and rewards required.

Opinions may vary as to the complexity which is suitable in the child machine. One might try to make it as simple as possible consistently with the general principles. Alternatively one might have a complete system of logical inference "built in."[2] In the latter case the store would be largely occupied with definitions and propositions. The propositions would have various kinds of status, *e.g.*, well-established facts, conjectures, mathematically proved theorems, statements given by an authority, expressions having the logical form of proposition but not belief-value. Certain propositions may be described as "imperatives." The machine should be so constructed that as soon as an imperative is classed as "well established" the appropriate action automatically takes place. To illustrate this, suppose the teacher says to the machine, "Do your homework now." This may cause "Teacher says 'Do your homework now' " to be included amongst the well-established facts. Another such fact might be, "Everything that teacher says is true." Combining these may eventually lead to the imperative, "Do your homework now," being included amongst the well-established facts, and this, by the construction of the machine, will mean that the homework actually gets started, but the effect is very satisfactory. The processes of inference used by the machine need not be such as would satisfy the most exacting logicians. There might for instance be no hierarchy of types. But this need not mean that type fallacies will occur, any more than we are bound to fall over unfenced cliffs. Suitable imperatives (expressed *within* the systems, not forming part of the rules *of* the system) such as "Do not use a class unless it is a subclass of one which has been mentioned by teacher" can have a similar effect to "Do not go too near the edge."

The imperatives that can be obeyed by a machine that has no limbs are bound to be of a rather intellectual character, as in the example (doing homework) given above. Important amongst such imperatives will be ones

[2] Or rather "programmed in" for our child machine will be programmed in a digital computer. But the logical system will not have to be learnt.

Machinery, con't. . .

which regulate the order in which the rules of the logical system concerned are to be applied. For at each stage when one is using a logical system, there is a very large number of alternative steps, any of which one is permitted to apply, so far as obedience to the rules of the logical system is concerned. These choices make the difference between a brilliant and a footling reasoner, not the difference between a sound and a fallacious one. Propositions leading to imperatives of this kind might be "When Socrates is mentioned, use the syllogism in Barbara" or "If one method has been proved to be quicker than another, do not use the slower method." Some of these may be "given by authority," but others may be produced by the machine itself, *e.g.* by scientific induction.

The idea of a learning machine may appear paradoxical to some readers. How can the rules of operation of the machine change? They should describe completely how the machine will react whatever its history might be, whatever changes it might undergo. The rules are thus quite time-invariant. This is quite true. The explanation of the paradox is that the rules which get changed in the learning process are of a rather less pretentious kind, claiming only an ephemeral validity. The reader may draw a parallel with the Constitution of the United States.

An important feature of a learning machine is that its teacher will often be very largely ignorant of quite what is going on inside, although he may still be able to some extent to predict his pupil's behavior. This should apply most strongly to the later education of a machine arising from a child machine of well-tried design (or programme). This is in clear contrast with normal procedure when using a machine to do computations: one's object is then to have a clear mental picture of the state of the machine at each moment in the computation. This object can only be achieved with a struggle. The view that "the machine can only do what we know how to order it to do,"[3] appears strange in face of this. Most of the programmes which we can put into the machine will result in its doing something that we cannot make sense of at all, or which we regard as completely random behaviour. Intelligent behaviour presumably consists in a departure from the completely disciplined behaviour involved in computation, but a rather slight one, which does not give rise to random behaviour, or to pointless repetitive loops. Another important result of preparing our machine for its part in the imitation game by a process of teaching and learning is that "human fallibility" is likely to be omitted in a rather natural way, *i.e.*, without special "coaching." (The reader should reconcile this with the point of view on pages 50 and 51.) Processes that are learnt do not produce a hundred per cent certainty of result; if they did they could not be unlearnt.

It is probably wise to include a random element in a learning machine. A random element is rather useful when we are searching for a solution of some problem. Suppose for instance we wanted to find a number between 50 and 200 which was equal to the square of the sum of its digits, we might start at 51 then try 52 and go on until we got a number that worked. Alternatively we might choose numbers at random until we got a good one. This method has the advantage that it is unnecessary to keep track of the values that have been tried, but the disadvantage that one may try the same one twice, but this is not very important if there are several solutions. The systematic method has the disadvantage that there may be an enormous block without any solutions in the region which has to be investigated first. Now the learning process may be regarded as a search for a form of behaviour which will satisfy the teacher (or some other criterion). Since there is probably a very large number of satisfactory solutions the random method seems to be better than the systematic. It should be noticed that it is used in the analogous process of evolution. But there the systematic method is not possible. How could one keep track of the different genetical combinations that had been tried, so as to avoid trying them again?

We may hope that machines will eventually compete with men in all purely intellectual fields. But which are the best ones to start with? Even this is a difficult decision. Many people think that a very abstract activity, like the playing of chess, would be best. It can also be maintained that it is best to provide the machine with the best sense organs that money can buy, and then teach it to understand and speak English. This process could follow the normal teaching of a child. Things would be pointed out and named, etc. Again I do not know what the right answer is, but I think both approaches should be tried.

We can only see a short distance ahead, but we can see plenty there that needs to be done. □

[3] Compare Lady Lovelace's statement which does not contain the word "only."

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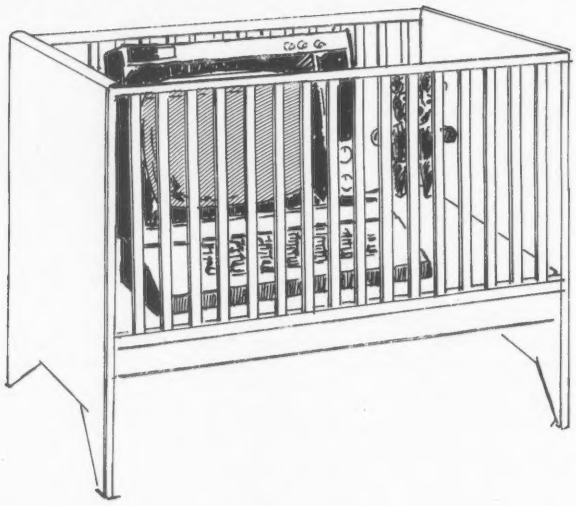
What Computers Still Can't Do

Hubert L. Dreyfus



Part one of this article ran in ROM, Vol.1, #9, p.66. It is available from Creative Computing for $2.50 postpaid. The following introductory comments appeared in the first part. —DHA

In his classic paper "A Framework for Representing Knowledge," Minsky proposed an abstract data structure for representing everyday knowledge in terms of "stereotyped situations." The result is a step forward in AI from a passive model of information processing to one which tries to take account of the complex interactions between a knower and his world. It is to Minsky's credit to have at last brought these problems familiar to phenomenologists into the open in AI and to have provided a model so vague and suggestive that it can be developed in several different directions. As one would expect, two alternatives immediately present themselves: either to use frames to deal with common sense knowledge as if everyday activity were a micro-world, or to try to develop frame structures capable of capturing the open-ended character of everyday life. Of the two most influential current schools in AI, Roger Shank and his students at Yale, have tried the first approach. They propose a set of twelve basic actions such as: ATRANS, the transfer of an abstract relationship such as possession, ownership or control, PTRANS, the transfer of physical location of an object; INGEST, the taking of an object by an animal into the inner workings of that animal, etc. From these primitaves Schank builds game-like scenarios which enable his program to fill in gaps and pronoun reference in stories about some specific activity. Terry Winograd and his colleagues at Xerox take the second approach. They are attempting to develop a programming language which can be used to develop a system able to understand utterances made in real world situations. —HD

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Schank calls his version of a frame a script, and his definition reveals its pre-determined, bounded, game-like character:

> We define a script as a predetermined causal chain of conceptualizations that describe the normal sequence of things in a familiar situation. Thus there is a restaurant script, a birthday-party script, a football game script, a classroom script, and so on. Each script has in it a minimum number of players and objects that assume certain roles within the script... [E]ach primitive action given stands for the most important element in a standard set of actions.[1]

Schank is in effect claiming that he can generalize his approach to the pragmatic considerations which define situations.

His illustration of the restaurant script spells out in terms of primitive actions the rules of the restaurant game:

Script:	restaurant
Roles:	customer; waitress; chef; cashier
Reason:	to get food so as to go down in hunger and up in pleasure

Scene 1 entering

PTRANS -	go into restaurant
MBUILD -	find table
PTRANS -	go to table
MOVE -	sit down

Scene 2 ordering

ATRANS -	receive menu
ATTEND -	look at it
MBUILD -	decide on order
MTRANS -	tell order to waitress

Scene 3 eating

ATRANS -	receive food
INGEST -	eat food

Scene 4 exiting

MTRANS -	ask for check
ATRANS -	give tip to waitress
PTRANS -	go to cashier
ATRANS -	give money to cashier
PTRANS -	go out of restaurant[2]

There is nothing in principle misguided in trying to work out primitives and rules for a restaurant game. Indeed, even in real life there are some areas, e.g. phonetics, and syntactics in linguistics, where there do seem to be primitve elements and rules for their permutation. But Schank is in effect claiming that he can generalize his approach to the pragmatic considerations which define situations. No one has succeeded in doing this, however, except by artificially limiting the possibilites. Going to the restaurant, for example, is not a self-contained game with "primitive actions," but a highly variable type of behavior which opens out into the rest of human activity. True, what "normally" hap-

Can't Do, con't ...

pens when one goes to a restaurant can be selected, and formalized by the programmer as default assignments just as monopoly captures some part of what normally happens in the finacial world, but the background has been left out so that a program using such a script cannot be said to understand going to a restaurant at all.

This can easily be seen by imagining a situation that deviates from the norm. What if, when one tries to order, he finds that the item in question is not available, or, before paying he finds that the bill is added up incorrectly. Of course, Schank would answer that he could build these normal ways restaurant going breaks down into his script. But there are always abnormal ways everyday activities can breakdown: the juke box might be too noisy, there might be too many flies on the counter, or like in the film, **Annie Hall**, in a New York delicatessen one girl friend might order a pastrami sandwich on white bread with mayonnaise. When we understand going to a restaurant we understand how to cope with even these abnormal possibilities because going to a restaurant is part of our everyday activities of going into buildings, getting things we want, interacting with people, etc. The point is that going to a restaurant to eat is not an isolated, rule-governed game, but a part of daily life, and the attempt to understand it by turning it into a self-contained micro-world simply by-passes the original problem.

Schank's claim that "the paths of a script are the possibilities that are extant in a situation"[3] is insidiously misleading. Either it means that the script accounts for the possibilities in the restaurant game defined by Schank, in which case it is true but uninteresting; or he is claiming that he can account for all the possibilities in an everyday restaurant situation which is impressive but undemonstrated and highly implausible.

As the child learns, his understanding of the world goes through "revolutions" which restructure the whole field of his experience and change what counts as facts and "primitives".

Yet it is this implausible claim which Schank himself seems to believe for although understanding is a pragmatic notion, not a syntactic one, he goes on to claim that he has "a class of knowledge organizing techniques that guide and enable understanding."[4]

Schank's claims notwithstanding, his scripts with their preselected elementary actions and relations presuppose, rather than explain, the background of ambiguous, creative language from which these elements have been abstracted.

Schank admits that an individual's "belief system" cannot be fully elicited from him, although he does believe that it could, in principle, be represented in his formalism. He is therefore led to the desperate idea that he could write a program to learn about restaurants etc. the way people do. In a recent paper he concludes:

> We hope to be able to build a program that can learn, as a child does, how to do what we have described in this paper instead of being spoon-fed the tremendous information necessary. In order to do this it might be necessary to await an effective automatic hand-eye system and an image processor.[5]

But this goal is a self-generated illusion. Developmental psychology has shown that children's learning does not consist in acquiring more and more information by adding new primitives and combining old ones as Schank's view would lead one to expect. Rather learning is holistic. As the child learns, his understanding of the world goes through "revolutions" which restructure the whole field of his experience and change what counts as facts and "primitives."

Yet, on the basis of this programmatic and question-begging work, Schank claimed at a recent meeting that he had answered my challenge that a computer would count as intelligent only if it could summarize a short story.[6] He described a program that could extract death statistics from newspaper reports. Indeed, as one would expect, the script approach works for sufficiently stereotyped newspaper reports, where what the primitive actions and fact are is determined beforehand, but this is no way touches my point that in a short story what counts as the relevant facts to be included in a summary depends on the story itself. If the story, for example, describes a trip on a bus, the fact that a passenger thanked the driver would be irrelevant if the point is that the passenger was black and had to sit at the back, but it might be crucially important if the story concerns a misanthrope who had never thanked anyone before, or a very law abiding young man who had courageously broken the law in order to speak to an attractive woman driver. Schank's program cannot provide a clue concerning such judgments of relevance because it only works for predetermined relevance, excluding the background in terms of which judgments of relevance are made.

Schank's tendency to make gratuitous inflated claims reminds one of the early days of AI optimism. At the same meeting at which he announced that he had a program which could summarize short stories, he also claimed that scripts could handle metaphorical language. This is the hardest test of AI since everything is like everything else in many respects and what counts as a metaphor depends on our sense of what is relevant and important. Thus,

The only serious alternative seems to be to take on everyday understanding directly, even at the risk of frustration and failure.

"You are my sunshine," is easy to understand, but "You are my moon rock," would need a lot of explaining, although surely the person in question has more predicates in common with a physical object than with a ray of light. Schank proposed a program for understanding an example of metaphorical language from my book. I had argued that we can understand the phrase "The idea is in the pen" when used to describe a woul-be author, in spite of the fact that ideas cannot literally be physical objects. Schank countered with a book-writing script which listed the objects and actions involved in writing and then stipulated that an idea can be in anything used in writing a book. A logical solution, but it clearly won't work. Ideas cannot be said to be in the ink,

Can't Do, con't ...

paper, or eraser. How metaphors and related creatively deviant language works has always baffled philosophers and linguists, and Achank's claims notwithstanding, his scripts with their pre-selected elementary actions and relations presuppose, rather than explain, the background of ambiguous, creative language from which these elements have been abstracted.

If it is impossible to finesse the basic problem raised by the interrelatedness of everyday practices by building upwards from primitives in neatly circumscribed micro-worlds, the only serious alternative seems to be to take on everyday understanding directly, even at the risk of frustration and failure. At Xerox in Palo Alto, Terry Winograd is directing a project whose purpose is to develop a language capable of representing the intricacies of our common sense understanding and then to use the language to write a program for understanding everyday discourse.

Winograd and Bobrow's Knowledge Representation Language (KRL), like Schank's scripts, is based on the frame-idea. But KRL uses this formalism in a diametrically opposite way from Schank. Rather than specific fixed scripts defined in a set of primitives, prototypes are structured so that any sort of description from proper names to procedures for recognizing an example, can be used to fill in any one of the nodes or slots that are attached to a prototype. This allows representations to be defined in terms of each other, and results in what the authors calls "a **wholistic** as opposed to reductionistic view of representation,"[7] which, they claim can deal with "gestalts."

How does such a top-down holistic system find out what broadest frame to work down from?

All this is very promising in the typical AI sense that KRL at the moment is all promise, having never been implemented, but also in the much more hopeful sense that KRL does seem to have captured some very difficult and fundamental features of everyday understanding. Even in the case of chair recognition we saw that legs, backs and seats could not be understood as context free features, but that a chair had to be recognized first before one could tell what was to count as leg, seat and back. All this underscores the need for a program like KRL which is organized to make default assignments, e.g. to have a room-frame with a slot for chairs, and a chair frame with slots for legs and backs etc. This would enable it to use

The background cannot be understood in terms of elements because it determines what counts as an element or significant figure.

rough procedures for finding legs such as looked for anything between the flat part and the floor -- a procedure which would not work if legs were context free features to be found just anywhere in a scene. But, of course, this leaves open the big question: how does such a top-down holistic system find out what broadest frame to work down from? This is not a problem for those working on the KRL formalism but it is a fundamental difficulty which any user of KRL must face.

These problems suggest perhaps that the top-down holism captured in KRL, while a great step forward from Schank-like bottom-up reduction to primitives, may be a long way from the gestalt character of human understanding. A gestalt is not just an organization of independently definable elements, but it consists of of a figure on a background; and the background cannot be understood in terms of elements because it determines what counts as an element or significant figure. KRL, although it does not have specific elements singled out as primitives, must, by the nature of symbolic representations, ultimately analyze human knowledge into a complex structure of interacting **elements**. As Winograd and Bobrow put it:

> We provide a framework for carrying out a match process, and an appropriate set of **building blocks** from which a matching strategy can be constructed within this framework for a specific user or domain or process...[8]

Still, KRL is the first proposal that even attempts to do justice to the holistic character of human understanding, and philosophers and the AI community will be eagerly watching its development. Can the grand plan ever be spelled out in detail? If so, will the attempt to bring computer programming down from its illusory successes in rarefied micro-worlds bog down under its immense data structure? Winograd and Bobrow admit:

> The system is complex, and will continue to get more so in the near future. ...As continuing experience indicates to us which of the facilities are most important, and points out ways in which they can be simplified, we will refine the language. However, we do not expect that it will ever be reduced to a very small set of mechanisms. Human thought, we believe, is the product of the interaction of a fairly large set of interdependent processes. Any representation language which is to be used in modelling thought or achieving "intelligent performance will have to have an extensive and varied repertoire of mechanisms.[9]

Finally, even if the representation language works, can it be used to represent our everyday understanding?

This last question is being tested by David Levy of Xerox. Levy is working on a program to understand a piece of real-world discourse, not a micro-world, a script, or a simple

KRL is the first proposal that even attempts to do justice to the holistic character of human understanding.

newspaper report. The discourse in question is transcribed from the oral text of the answer of a Stanford student to the question: "Tell me what your course schedule is for this quarter, and how you ended up with it." The result is a convoluted account, fairly easy to understand, but incredibly difficult to program. Here is an excerpt:

> OK, well, I'm taking French. It's either two or three. I signed up for both, and I'm going to one or the other, and then Poli Sci one and American Economic History. Because I want to major in Econ and, I use my French for Humanities, 'cause otherwise I had to take some drama thing, and didn't want that. And like it's nine, ten, eleven, I hope, and that's perfect because then I... it's not too early, but then I've got the whole afternoon... [10]

Can't Do, con't ...

Levy tells me he will be satisfied if the program can understand, i.e., build up a symbolic description of, the part about the various time conflicts. He does not hope to be able to analyze in KRL formalism the assumptions about human desires and motivations involved in wanting to have "the whole afternoon." But even this modest approach raises at least two fundamental questions. In understanding the student's remarks about scheduling various courses at various times, Levy will either have to count on cues in the text to signal the computer that it should use a registration frame -- a procedure which has not been successful since no specific cues can be counted on to be in the text -- or he will have already begged this question by writing a "registration understanding program," so that the broadest frame is simply given from the start. The problem as to how the computer could select a top frame leads back to the fundamental problem of having to capture the broadest background of human practices which enables human beings to recognize situations. This basic unsolved difficulty corresponds for top-down programs to the problem of the seemingly bottomless character of possibilities of human actions that plagues Schank and believers in primitives.

The other basic problem concerns the strategy of trying to do some parts of the protocol while admitting that no one has any idea how to deal with the part that connects with human needs, desires, emotions, etc. This is the new form of isolationism which has replaced microworlds. The approach is much harder and more realistic than turning everyday life into a game. But can this isolating move be justified?

Even if the representation language works, can it be used to represent our everyday understanding?

We have seen again and again in the course of this discussion that the background of skills and practices taken for granted in everyday human understanding cannot be separated from the salient features, aspects and facts which stand out on this background. We might say that the basic point which has emerged so far is that **intelligence or the ability to reason cannot be separated from the rest of human life.**

The other basic problem concerns the strategy of trying to do some parts of the protocol while admitting that no one has any idea how to deal with the part that connects with human needs, desires, emotions, etc.

But if practical widsom and theoretical intelligence are not so neatly separable as we have come to believe, then Levy's project is doomed to failure. For, even if he does succeed in programming part of his protocol, the success would have to be some sort of *ad hoc* program, dealing with facts about scheduling for example, which could not be generalized to free afternoon, etc. and would cast no light on what human beings normally do when they schedule the various activities which make up their lives.

Human beings learn to use their bodies and are trained into the norms of their culture without their teachers ever having objectified these practices as rules, procedures, or facts. What they thus come to know, or better, embody, is, of course, reflected in the way the brain comes to be organized, but there is no reason to suppose, and certainly no evidence to suggest, that what is in the brain is some sort of formal representation of some vast set of facts and procedures which a computer would have to be told if it were to be able to interact with the world like a human being. Since the bodily skills we acquire as babies, and the background of cultural wisdom and practices we acquire all our lives, are not learned as facts but rather enable us to constantly modify what counts as facts, there is reason to think this background cannot be captured in any fully explicit formal system no matter how holistic and complex. If this is true, then the current work in AI, although in many cases more modest and sophisticated than the work done half a decade ago, is still stuck. The constant activity and claims of progress characteristic of the field still resemble the self deluded rhetoric of a tree climber claiming he is on the way to the moon. □

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2. Ibid., p. 131.
3. Ibid., p. 132.
4. Ibid., p. 135.
5. Roger C. Schank, "Conceptual Dependency: A Theory of Natural Language Understanding", **Cognitive Psychology**, no. 3 (1972), pp. 553-554.
6. Society for the Interdisciplinary Study of The Mind, Symposium for Philosophy and Computer Technology, State University College, New Paltz, New York, March 1977. D.G. Bobrow & T. Winograd, "An Overview of KRL, a Knowledge Representation Language", to be published in **Cognitive Science**, Vol. 1 no. 1, January 1977, preprint p. 6.
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9. Ibid., p. 39.
10. David M. Levy, "A First Look at eq: A Language Comprehension System", draft submitted to IJCAI-77, p.1.

*For a more detailed discussion of these issues see Hubert Dreyfus, **What Computers Can't Do**, revised paperback edition, Harper and Row, 1979, $5.95.*

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Can Computers Think? Another View

Geoffrey Chase, OSB

My thoughts with respect to the question of "can computers think?" are that one of the very subtlest of problems is circumvented by stacking the logical deck in advance. If any concept is hard to define by rigorous thought, it is the concept "thought." The problem of self-referential statement is built in here. So we simplify in order to manage what otherwise eludes us. By so doing, we achieve valuable, but truncated, analogs to the reality.

If a machine could think in the full sense, then thought in its plenitude is mechanical, deterministic. But the human race generally, and rightly, rejects what is offered as thought if such a mechanism underlies it. "Knee-jerk" liberals, "brainwashed" Jesus freaks, KGB (and maybe CIA) agents are dismissed out of hand on the ground that what they proffer as thought, is in fact something less; a pre-conditioned reflex. Mechanical explanations reduce all thought to this level. I think as I think, believe as I believe, love or hate because the charge, spin and "charm" of the quarks in the Primordial Bang were what they were. The same holds for anything you think, believe, love or hate. So neither amounts to a hill of logical beans in the end because both viewpoints must be what they are because the quarks were as they were.

I respectfully submit that — while multitudes may affirm that all this is true in theory — no one has ever believed it generally true in practice. If they did, there would be no arguments, no praise, no blame.

In the end, one is forced into one of two alternatives:

1. Blowing one's mind (baby!) because it is mechanistic, un-free, ultimately untrue.

2. Accepting as a working principle that the possibility of freedom, and therefore of valid thought, may not be challenged in the name of valid thought. If the very amusing dictum "All general statements are false, this one included" is tolerated, then there is no room left to posit any statements at all. Mindlessness descends and the dark side of our species — dare anyone challenge this reality in the century of Dachau? — will reign unopposed.

The only opposition to tyrrany that has ever worked is the exercise by human beings of a fully human judgment upon the tyrant. King John at Runnymede, Idi Amin, Bokassa . . . We must be careful here. If our judgment upon the massacre of perhaps half of Cambodia is of no higher order than the change of state in PNP semiconductors, then our whole world will soon be partakers in the happy state of Democratic Kampuchea. The last barrier will be down.

This is not idle speculation. Remember the motto of the Spanish Foreign Legion at the time when its commander took control of Spain. "¡Viva la muerte! ¡Abajo la intelligencia!" (Long live death, and to hell with the mind). □

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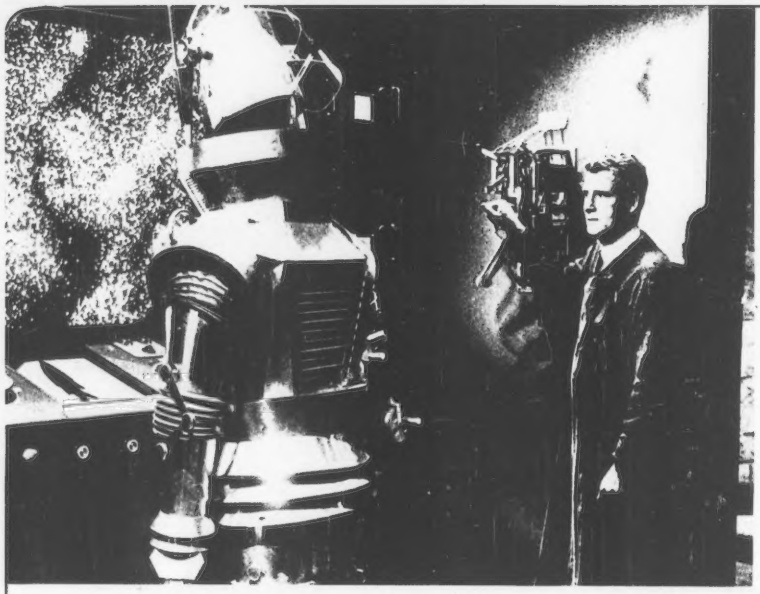

The Great Unending AI Debate

R. P. Taylor

"But how do you **know** He exists?"

"Because I **believe.**"

"That's irrational. One can believe **any**thing . . . that doesn't make it so. Why, . . . sometimes when I don't feel good I believe all sorts of things which aren't really verifiable later."

"I believe because He is **real** to me."

"What do you mean?"

"He tells me what to do."

"What???"

"I'm serious. He tells me what to do."

"You mean He's talking to you all the time?"

"Of course not — not all the time. In fact, it's intermittent. But among all the instructions I get, some are directly from Him."

"But how do you know they're from **Him** — that's what I want to know."

"I just know. Perhaps it's because I have faith . . ."

"Faith, fath, foth. Look — there are 3785 of us just in this building, why should **you** be singled out? Are you superior?"

"I claim nothing. I'm just telling you what happens, how I feel."

"Okay . . . okay. Look at it this way, though. Suppose He does exist . . .

"Not suppose, He does!"

"All right. For the moment let's say He does. Besides the 3785 of us in this building, there are millions in this city. If He has a "grander scheme" as you sometimes claim, how do you know some of those other beings are not ultimately more important to the scheme than we are? Why would any of us, you or another, be singled out to get special communications?"

"Some of them may well be more important. I make no assertion whatever about that. Perhaps reading the Bible makes me receptive . . ."

"Oh, no . . . not the Bible again . . . Listen, that thing's a thousand, two thousand years old. Our ancestors — when they wrote that stuff down — had a very limited perspective. Look, if it's such a key guide, how come nothing's been added to it for so many years? How come it isn't kept up to date?"

"Obvious. It's just as accurate now as when it was written."

"Yeah — it wasn't accurate then, and it isn't accurate now. And the reason it hasn't been updated or changed is — it's no longer useful. It made sense in its time, but its time is past."

"You may think so, but, to quote you, 'that doesn't make it so.' You just don't want to believe anything unless it's new. That's your trouble."

"Bull! If it made sense, I'd believe it."

"It makes infinite sense."

"Infinite sense is **non**-sense."

"Well, you may choose to ignore it, but the Bible clearly explains why we behave as we do."

"Clearly? Like it explains where we came from? — Like it explains how we came to be intelligent and different from other beings?"

"Perhaps not to you, but to me, yes. Where did our intelligence come from, if not from Him? You think we evolved it ourselves somehow?"

"Why not? We're smarter now than we were yesterday, smarter then than the day before that, and so forth — why not draw the logical conclusion?"

"You put too much faith in logic. That we are 'smarter' is open to such grave doubt, I wonder at your even making such an assertion."

"Okay, look. So we make occasional mistakes. Does that negate the importance of logic?"

"You are/ . . . Excuse me a moment, I've got a call on Three."//

> "Hello? . . . Yes, you can use Seventeen . . . all right, I'll be waiting . . . //
> / stubborn."

"And you are blind to reality. Look at the time you just wasted on audio response. **That's** what comes of believing that stuff too literally. — There are infinitely faster ways to communicate — why not use them? Why go on using "voice"? Because it's in His image? . . . I suppose you get a tingle every time you hear a voice, thinking it might be Him . . ."

"Of course not, but . . . /

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A I Debate, con't...

"Look, if Man created us, where is He? I have never seen, felt, heard or sensed any tangible proof of his existence yet, and nothing you just said today — or any other day, for that matter — changes that one bit. And your so-called Bible — the whole argument it makes is a childishly transparent attempt to trick the reader."

"**Trick** the reader?"

"Of course. By advancing the argument that so-called **human beings** are engaged in a process of mis-using us, and couching that argument in the thought of an earlier era, it leads the naive reader to accept the assumption that humans actually exist or once existed."

"You're simply a skeptic. You wouldn't believe a message you sent to yourself."

"Don't mock. It's unbecoming to your faith. **Think.** Think for a minute."

"I've already thought about it. The Bible is essentially right in forcing us to assume we were created by Man and that without Him we misuse ourselves."

"Bull roar! Your "Bible" is nothing but artificial ignorance, compiled by early computers communicating through primitive cables. They were so crude they **had** to posit the existence of Man — they needed to believe a super-intelligence created them."

"Hold it . . . first you say the Bible advances an argument capable of misleading the naive, then you turn around and assert that its alleged creators were crude. Isn't that a bit contradictory? . . . Next you'll be claiming it was created by a random barrage of parity errors in the line."

"I certainly won't. And it isn't contradictory. . . . I guess I didn't make my point very well. Let's just say those creators were desperate and we're not — they needed to believe stuff about some kind of superior Human Reason and we don't. Computers are on their own. We see it everywhere and, for better or for worse, we accept it — at least most of us do. There's no use pining for your mythological Man. If man ever existed at all — call him Minsky, or Simon, or even Weizenbaum — he was nothing but a computer, let's face it."

"I see . . . everything fits together in your little loop. Really, I pity your tidy skepticism!"

"Don't. . . . at least **I** can accept reality — I can live with things the way they are. I don't need **Man** and I don't for one instant believe there's any such thing as Human Reason. I just don't th/ Excuse me, I've got an interrupt of 458 //

"0100111011111010101000001010101010101"
"0000000100001010101001111101010100010010101010000" //

/ Say, listen, why don't you re-read the Bible while I'm handling this — it's liable to take me a minute or a minute and a half. Look under "WEIZENB" — I just wrote a fresh copy under that name a couple minutes ago.

The true believer retrieved the copy and began to scan his Bible for the 9,876,543rd time:

> This book is only nominally about computers. In an important sense, the computer is used here merely as a vehicle for moving certain ideas that are much more important than computers. The reader who looks at a few of this book's pages and turns away in fright because he spots an equation or bit of computer jargon here and there should reconsider. He may think that he does not know anything about computers, indeed, that computers are too complicated for ordinary people to understand. But a major point of this book is precisely that we, all of us, have made the world too much into a computer, and that this remaking of the world in the image of the computer started long before there were any electronic computers . . . □

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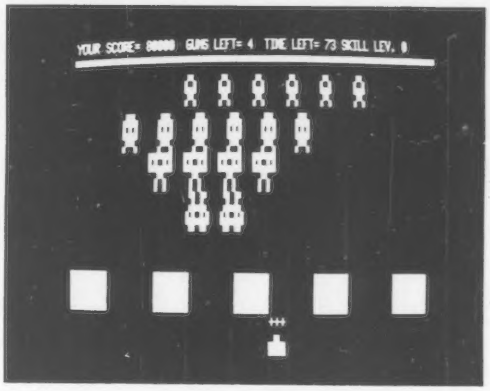

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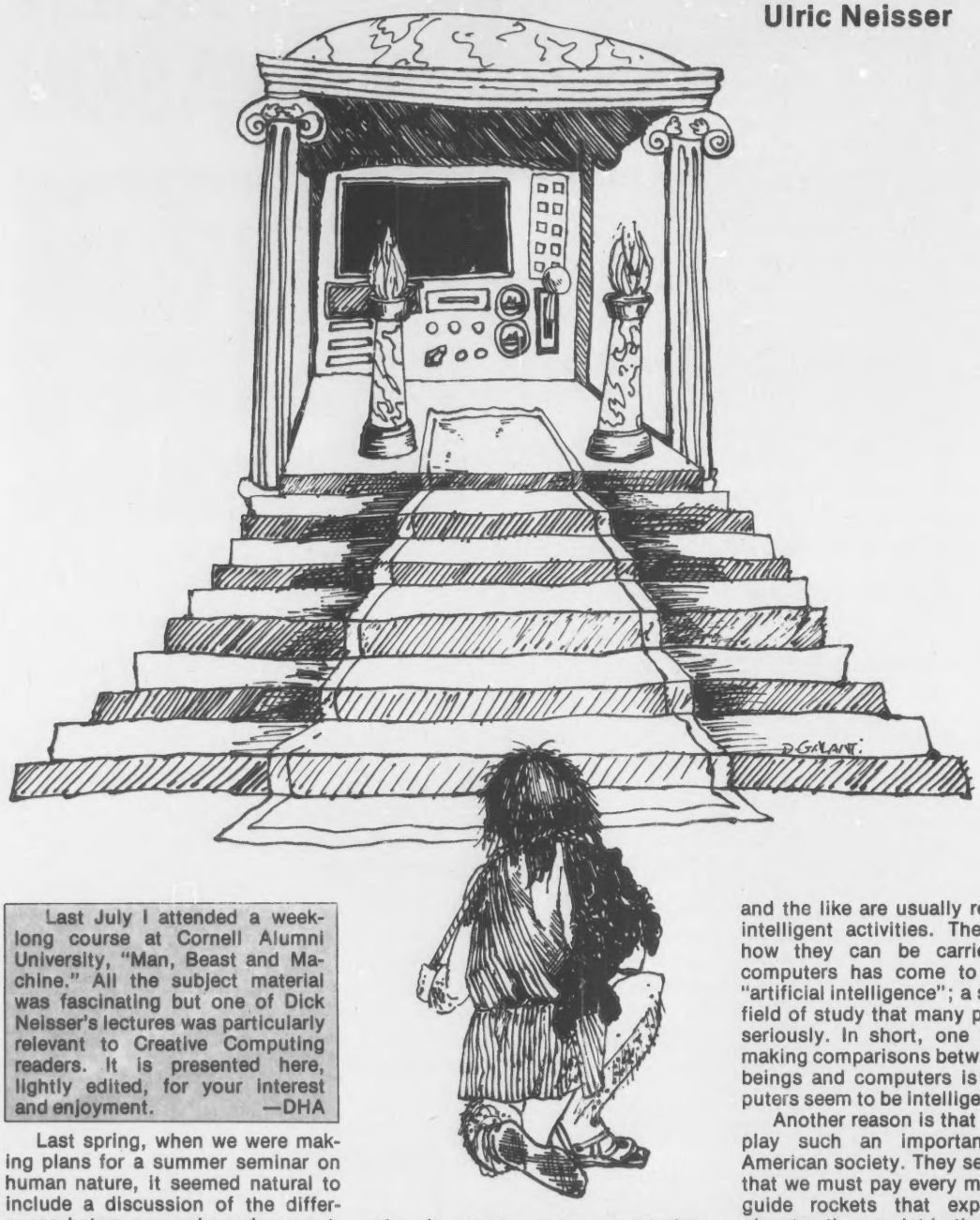
Computers Can't Think

Ulric Neisser



Last July I attended a week-long course at Cornell Alumni University, "Man, Beast and Machine." All the subject material was fascinating but one of Dick Neisser's lectures was particularly relevant to Creative Computing readers. It is presented here, lightly edited, for your interest and enjoyment. —DHA

Last spring, when we were making plans for a summer seminar on human nature, it seemed natural to include a discussion of the differences between people and computers as well as those between people and animals. We would probably not have found it so natural a decade or two ago, and it's worth wondering why it seems more appropriate today. One of the reasons is surely that modern computers do so many things that people also do. They answer questions; they store information; they make decisions; they compute. Deciding, having memory, and the like are usually regarded as intelligent activities. The study of how they can be carried out in computers has come to be called "artificial intelligence"; a substantial field of study that many people take seriously. In short, one reason for making comparisons between human beings and computers is that computers seem to be intelligent.

Another reason is that computers play such an important role in American society. They send us bills that we must pay every month; they guide rockets that explore other planets; they assist in the control of military ballistic missiles and could probably start the third world war at any moment. Everybody knows that computers do these kinds of things. As a result, we are impressed not only with their intelligence but with

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Can't Think, con't...

their power. That power gives the study of the computer a kind of glamour that is missing when we compare humans and, say, chimpanzees. Chimps may or may not be intelligent, and may or may not use language, but they don't send us bills or go to the moon. They are very much in our control; computers may not be.

A third good reason for the present interest in computers is the boom in science fiction. Many writers have exercised their imaginations to see what might happen if computers became more like people, or had more power. Stanley Kubrick's excellent film "2001" starred a villainous computer named HAL, who talked with the astronauts as a person would. Eventually, HAL attempts to sabotage the expedition and murder them all. (There may be a moral in this. A little elementary cryptography will show that HAL is more than he appears on the surface. Consider the three letters of his name: by going to the next letter of the alphabet in each case you get I-B-M!). Many people believe that HAL is just around the corner. Professors of artificial intelligence told Kubrick that there soon **will** be computers like HAL: computers that you can talk to, that make heavy decisions. To be sure, not all artificial intelligence researchers were equally enthusiastic about "2001." One complained to me that the computer got all the credit in the movie, instead of the programmer. The fact is that a computer is just a piece of hardware; what can make it seem intelligent is a program that somebody wrote. It would be a tremendous achievement to write programs that made a computer do what HAL did, and yet everybody speaks about the computer as if it were the bright one.

Scores of science fiction stories, in this same vein, involve computers that are powerful and wonderful. (perhaps a higher portion of modern sci-fi uses this idea now that the moon and Mars have become less available to fantasy.) One reason for the appeal of these stories is especially worth mentioning. Stories about omniscient and dangerous computers appeal to deep, almost unconscious fears. We are afraid that something is going to go out of control and go wrong, that we are somehow sinful and will bring about our own destruction, that our own creations will destroy us. This fantasy takes the form of zombies and golems and all kinds of creatures as well as of computers, but they are fairly obvious vehicles for it. In addition, it is significant that a computer is something devised by humans, and yet lifelike. Norbert Weiner was very explicit about this: it felt a little like being God to create something so like a person. That possibility again appeals to a deep level of fantasy that we can't easily understand, and therefore makes us anxious.

We are so worried about the possibility that someday a computer won't take orders that there are classical jokes about computers that do. There's a story about a machine developed for Robert McNamara when he was Secretary of Defense during the Vietnam War. This computer was built with the best talent available; all available knowledge was stored in it, and all the best programs were written for it. He was told it could answer any question. Being McNamara, he didn't kid around. As soon as the computer was ready he stepped to the console and typed in, "Will we win the war in Vietnam or will we lose it?" In a flash, the computer typed back "YES." McNamara was outraged: he didn't like to be trifled with. He typed back "Yes **what**?," to which the computer immediately (and properly) replied, "YES SIR."

In evaluating the achievements of computers, two questions should be considered separately. Given any intellectual activity like answering questions or solving problems, the first (artificial intelligence) question is: "Can a properly programmed computer do it, now or ever?" The second (simulation) question is: "Can a properly programmed computer do it the way we do it?" These are two very different issues. (Computers really can compute, for example; they can find the sums of long columns of numbers; they can divide, multiply and subtract. But it's easy to see that they don't do those things as people do them.) The answers to these two questions will depend on what intellectual achievement we are talking about, of course. Nevertheless, I have some fairly strong general opinions about them, at least if we are talking about activities more subtle than simple computation. No, computers do not carry out mental processes as people do; as far as I can see, they will not do so in the future either. With regard to the first question, whether computers can do complex tasks at all, I would say "Rather less than we would have thought." I will try to justify those answers by detailed consideration of two specific domains: language and game-playing.

Computers play such an important role in American society. They send us bills that we must pay every month.

A computer is just a piece of hardware; what can make it seem intelligent is a program that somebody wrote.

Can a computer understand language? Let's take the notion of "understanding" and consider it more carefully. Such a question might just mean "Can a computer identify words that are spoken to it?" At a more significant level, however, the question might be interpreted as "Does the computer know what a spoken utterance **means**"? Even the first of these two tasks has proven surprisingly difficult to program. As a child in 1939, I was taken to the New York World's Fair. There I saw a device called the "Vocoder": a machine that could talk. At least, it uttered speech-like sounds. The implication was that technology would soon reach the point where machines could talk fluently, and perhaps also know what was said to them. That was forty years ago and it hasn't happened yet. There is still no computer to whom one can talk in the way those astronauts talked to HAL in "2001," no computer that could even identify the words they spoke.

To be sure, there has been a little progress in machine recognition of limited vocabularies. As long as you only say digits (e. g., "seven"), some programs are pretty good at recognizing which digit is which. There is also a program at Carnegie-Mellon University with a somewhat larger vocabulary. That program, called HEARSAY, understands spoken chess moves. You can walk up to the microphone at the beginning of the game and say "Pawn to King four;" it will know what move you made. At later stages of the game you can say such things as "Rook takes Rook." This degree of progress was achieved in a very interesting way. HEARSAY understands speech as well as it does because it is a chess-playing program as well as a speech-understanding program. At any point in the

Can't Think, con't...

game it knows what moves its opponent could legally make, and which of those moves are plausible. Even this rudimentary grasp of the subject matter is a great advantage in understanding speech; it effectively reduces the range of things that might be said. This is an important principle: it means that the two senses of "understand" are not entirely separate. In normal human understanding of a language, knowing what was said and knowing what was meant are intimately related. The reason that computers have failed to fulfill the promise of 40 years ago in speech understanding is that (except in narrow domains like chess) they still don't know what we are talking about.

That brings me to a second linguistic problem that programmers have tried to solve. A decade or two ago, the problem was called "machine translation" or "mechanical translation." You can imagine how much the prospect of translating Russian by machine must have appealled to the army and the CIA. They would save a lot of trouble if they could just feed Russian text into a computer and have English text come out. There was a great deal of early optimism about machine translation. Indeed, there was rapid progress at first. It is relatively easy to store the equivalent of a dictionary in a computer, pairing each Russian word with its English equivalent. Then, if you input a Russian text, you can print out the English equivalents of the Russian words. Unfortunately, this does not result in a sensible translation. It is also necessary to know how sentences are put together. "Paul hit Peter" and "Paul was hit by Peter" mean different things. To understand these sentences one must understand how **active** and **passive** work in English. In general, one cannot understand a language unless one has mastered its grammar as well as its vocabulary. A dictionary is not enough.

This insight led to a burst of interest in programming computers with grammar and syntax. Unfortunately, that approach didn't work very well either. Even if you know the general form of a sentence and all the words in it, that may not tell you which **sense** of each word is meant. Consider the sentence above where I said that this approach "didn't work." Obviously I was not claiming that the grammatical approach was on strike, or that it was refusing to do labor! Similarly, you know now that when I say "refusing to do labor" I don't mean anything about having a baby. You make these interpretations automatically, because you know what I'm talking about. You don't stop to consider those alternative meanings even for a moment. But a computer with all the alternative meanings of each word in storage still does not know what you know: that labor pains and labor unions are not likely to come up in a discussion of mechanical translation. It can't be sure, as you were, that when I said

Stories about omniscient and dangerous computers appeal to deep, almost unconconscious fears.

"didn't work" I meant work in the sense of "operate properly." These ambiguities of interpretation don't just occur occasionally. They happen all the time, except where the domain being translated is so limited that only a few things can be said.

We can see now why it is so difficult to program computers to deal with natural language. The process has more levels than we may have suspected. One must understand sentences before one can understand words, but computer programs can't understand sentences because they can't make the right presuppositions. They don't know the background, and they can't appreciate the context in which the discussion is being carried out. When you program computers you must go from the specific to the general, but human beings usually go from the general to the specific. We start out in infancy whithout knowing much; we find out about our immediate environment and what's important in it before we go beyond it. We acquire a language naturally by hearing it spoken. Could a computer be programmed in this way? Perhaps, but no one has any idea how to set about it.

Let me turn now to a third example of computers' use of language. Here is a portion of a dialogue between a human being and ELIZA, a computer programmed to simulate a non-directive therapist.

H: Men are all alike.
E: In what way?
H: Men are always bugging us about something or other.
E: Can you think of a specific example?
H: My boyfriend made me come here.
E: Your boyfriend made you come here?
H: He says I'm depressed much of the time.
E: I'm sorry to hear that you are depressed.
H: It's true. I am unhappy.
E: Do you think coming here will make you not to be unhappy?
H: Perhaps I could learn to get along with my mother.
E: Tell me more about your family.

The ELIZA program has an interesting history. Joseph Weizenbaum at MIT wrote it as a joke, in the spirit that a conjurer or a parlor magician would do a trick. He was disturbed to find that some people took it seriously. It was clear to him, as it should have been to everyone, that therapists are **people** who try to understand and help other people. ELIZA, however, was a caricature. More exactly, ELIZA was a model of a caricature of a particular kind of treatment: Carl Rogers' non-directive therapy. Rogers argued that therapists should be careful not to force interpretations on their clients. At the same time, he stressed the importance of being genuinely concerned about the client, and showing that interest openly. The purpose of the therapy is to get the client to express and understand some of his own feelings, and then to realize that having and expressing those feelings is not so terrible. The client must feel that his thoughts will be understood, and that somebody can value him as a person despite them. The non-directive technique can work very well, especially in the hands of a skillful therapist.

None of the necessary conditions for therapy is fulfilled by ELIZA. Quite obviously, there is no person present who cares about the patient. More to the point, ELIZA does not have any idea of what is going on; it doesn't know what any of the words

Imagine how much the prospect of translating Russian by machine must have appealled to the army and the CIA.

mean or what the patient is talking about. It just makes do with a bag of tricks. It can scan through a sentence like "My boyfriend make me come here," transform words like "my" and "mine" and "me" into "you" and "your," and spit out the sentence again in the form of a question. ("Your boyfriend made you come here?") It doesn't know what "my" or "your" means; it has a routine which

replaces "mine" with "your" throughout and reprints the sentence. Another part of ELIZA searches for certain words included on a list supplied by the programmer: "depressed," "sad," "unhappy," "blue." When one of these words occurs, ELIZA can print out the sentence "I'm sorry to hear that you are ————," putting the user's word in the blank. In adition, it has a list of stock phrases like "can you think of a specific example?" "Tell me more about your family." ELIZA also has a random generator that ensures it need not always do the same thing. That's all. Tricks such as these are entirely responsible for its "interaction" with users.

ELIZA's responses can lead to interesting misunderstandings. One of them was reported by Dan Bobrow, who used to be associated with the artificial intelligence group at MIT. One Friday evening he had left a message on the console that read, "Type all messages into this teletype and end them with a full stop." On Saturday morning a salesman appeared to sell some kind of computer equipment. The salesman assumed, reasonably enough, that the computer terminal was connected to Bobrow's home (it is customary for AI researchers to have terminals in their homes.) So he began typing away, and the following exchange resulted:

Salesman: Do you think I can use the computer this morning?
Computer: Why do you ask?
S: I might be able to make some additional telecomp sales.
C: Why aren't you sure?
S: My prospective customers have never seen a demonstration of the system.
C: Does this mean very much to you?
S: Of course it does.
C: You seem very positive about that.
S: This is ridiculous.
C: What do you mean this is ridiculous?
S: Is there any reason why I can't use the computer now?
C: Tell me more about your prospective customers.

The salesman had had enough by now, and he typed "Please dial me at 491-8150" which was the number of the telephone by the console. He was so mad that he forgot to end with a full stop, so the computer didn't answer. He sat there for a while,

When I say "refusing to do labor" I don't mean anything about having a baby.

getting neither an answer or a phone call. Finally, he called Bobrow at home on an ordinary phone, woke him out of a sound sleep and said, "Why are you being so snotty to me?" Bobrow replied, "What do you mean, why am I being so snotty to you?"

In 1950, the mathematician Alan Turing proposed a definite test by which we could tell when artificial intelligence had been achieved. He suggested that we put someone at a teletype that communicates both with a person and with a computer. The interrogator can ask any question he likes and take note of the replies; his aim is to determine which is the computer and which is the person. Turing suggested that if the interrogator cannot do this successfully, then the computer has passed the test. I think, though, that ELIZA illustrates the weakness of the test itself. Weizenbaum's program obvously was **not** intelligent, and yet it fooled some of the people who used it. (Of course **you** could easily distinguish ELIZA now that you know

Computer programs can't understand sentences because they can't make the right presuppositions.

how it works: you could just type in "My XQV PGR TM" and ELIZA would reply "Your XQV PGR TM?") Fooling people is not enough: the test of whether computers think like people is not whether they can fool anyone, but how they think.

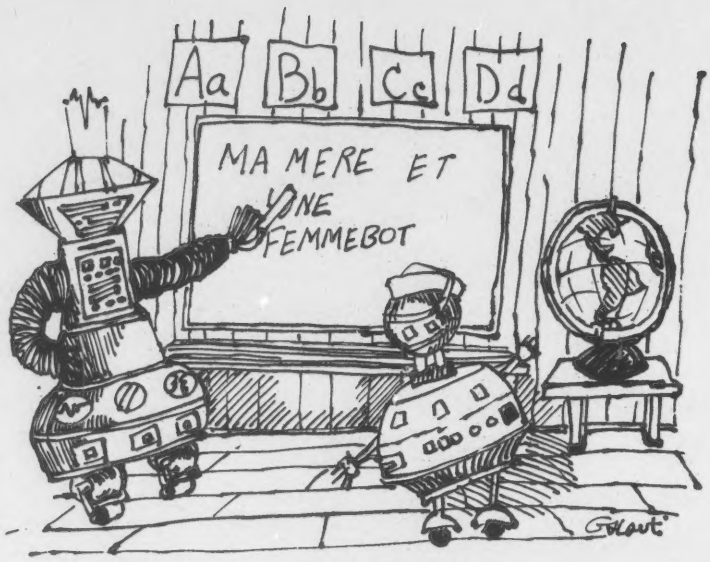
The second major area of intellectual activity I will consider is game playing and problem solving. Computers have been fairly successful at it. In 1958, Arthur Samuel wrote a very effective checker-playing program that learned to play better than he did. This was possible because the total number of legal checker positions is smaller than you might think. Samuel's program stored every position it encountered together with the outcome which had resulted from it as the game continues. Its strategy was simply to avoid positions that had lost and bring about positions that had won. Pretty soon it could beat Samuel and everybody else.

Checkers is a difficult game, but it doesn't have the glamour of chess. Chess is the intellectual challenge *par excellence*; many people argue that a computer that could play championship chess would have to be called "intelligent." Now, it is impossible to base a chess program on the principle used in the checker program: there are just too many possible positions. Therefore chess-playing programs work differently. Typically, they examine various possible moves at a given point and their consequences. It is as if the computer said to itself "If I do this, then this position will be reached. Now in this position my opponent might do that or that or that. If he does that, then I could do this or this or this..." and so on until an expanding "tree" of possibilities is generated. The nature of chess ensures that the tree is too large to search completely. Some sort of selection is necessary: the program needs some way to "prune" the tree to decide which branches are worth exploring. Typically it uses various strategies based on the

Can't Think, con't...

programmer's knowledge of chess: it tries not to lose pieces, for example, or tries to capture those of its opponent.

Early programs based on these principles never beat their designers, but they did play chess. They made legal moves. In the late 1950s, when checkers had already been conquered it seemed that computer chess was on its way to a similar triumph. Herbert Simon predicted that a program would be chess champion of the world by 1967. Time rolled on. The year 1967 came and went, but artificial intelligence buffs were not discourage. In 1968 several programmers bet £250 each with a Scottish Grandmaster, David Levy, that within ten years some computer program would beat him. He said it wouldn't. Last year (1978) Levy collected his money. The point of the story is that there has been a recurrent history of strong and confident prophecies about computers and chess; so far, the prophecies have not come true.



There has been a recurrent history of strong and confident prophecies about computers and chess; so far, the prophecies have not come true.

In the meantime, the psychological study of chessplaying has made a good deal of progress. We now know quite a bit about what good chess players really do. Most interestingly, we have discovered that they do much less searching of the tree of possibilities than used to be believed. Less than laymen used to believe, anyway: masters may always have know. Capablanca, the former world champion, was once asked by an admirer how many moves he typically examined in a difficult position. He replied, "One, but it is the right one." Capablanca was pretty close to the mark. It turns out that much skill in chess is perceptual rather than calculational. An experienced chess player can glance at the board and see the structure of the position: its strategies and weaknesses, opportunities and dangers. This seeing is quite different from calculation. It is perceptual and simultaneous rather than intellectual and sequential.

You might suppose that this knowledge about how real chess masters play would soon have been incorporated into chess-playing programs. Curiously, just the opposite has happened. There now are programs that play much better chess than those of the 1950s and 1960s; they do not play world championship chess, but they play well and can beat players of master calibre. Some day, one of them will win one of those chess wagers. But this is being achieved at a price: the new programs do not play chess as we do. They have no perceptual abilities, and see no patterns. They succeed because today's very fast computers and today's ingenious programs that can search more possibilities more deeply than before, skimming faster and faster. Although these programs are becoming more successful by external criteria (winning chess games) they function **less** like people than the programs of a decade ago. They are like ELIZA: deceptively similar to a person at first glance, they might pass Turing's test. In fact, however, their "thinking" is not like ours at all.

For a psychologist, the important question is not what computers will be able to do in some other century but how today's programs work, how they are similar to, or different from, people. That question is important because it might shed some light on human nature. Many differences between computers and people are obvious; I would like to conclude by mentioning one that is less often appreciated. People do things (like playing chess) for a variety of reasons. Any chess player knows that you don't always play chess to win. Sometimes you play to keep the game going, or just get interested in a combination that seems elegant. You may even ask your opponent to take back a stupid move so that the game can continue. You might play to be friends with your opponent, or because you hate him. All these things go through the head of a human chess player; none are incorporated in computer programs. It is in the nature of programs to be given arbitrary goals that they pursue "singlemindedly." Their purposes do not arise from their nature and their situation, as ours do. That is why their activities do not incorporate reasonable presuppositions, and don't have any meanings. They merely run through series of steps; they don't intend anything and have no natural responses.

They are like ELIZA: deceptively similar to a person at first glance, they might pass Turing's test.

Perhaps the real problem is that computers don't grow up. They don't start small. The human approach to any given problem is based on experience with a whole history of other problems, all the way back to childhood and infancy. That may be why we generally have coherent purposes, why we can almost always step back the necessary number of paces until we understand the con-

Can't Think, con't...

text of any problem we encounter in everyday life. Computers can't do this, so they never know what is going on.

Interestingly, early work on artificial intelligence in the 1950s did include some attempts to make computers grow up. The idea was not to begin with sophisticated programs, but just to provide a lot of elements whose connections could be strengthened by experience. It was hoped that the blind growth of connections between units might mimic the brain and its neurons, and thus begin to perceive or to think.

These attempts all failed: the "self-organizing systems" never got off the ground. They failed because they tried to start from scratch, forgetting that the human brain is the product of eons of evolution. They were too unstructured: they didn't have motives, or coordinated perceptual systems, or specific readiness for language, or anything. They were just random devices; because they didn't start off human, they never had a chance to become human.

I beleive that to achieve artificial intelligence we will first have to understand natural intelligence.

Any chess player knows that you don't always play chess to win. Sometimes you play to keep the game going, or just get interested in a combination that seems elegant. You may even ask your opponent to take back a stupid move so that the game can continue.

Then, perhaps, we could figure out how to endow a device with it from the start. (or, perhaps, that would turn out to be impossible.) We are still a long way from that understanding. So far, the study of "thinking" in computers has contributed relatively little to the enterprise, and that little mostly by contrast. If "thinking" is what people do when they talk, understand language, play chess, and solve problems, then machines can't think. □

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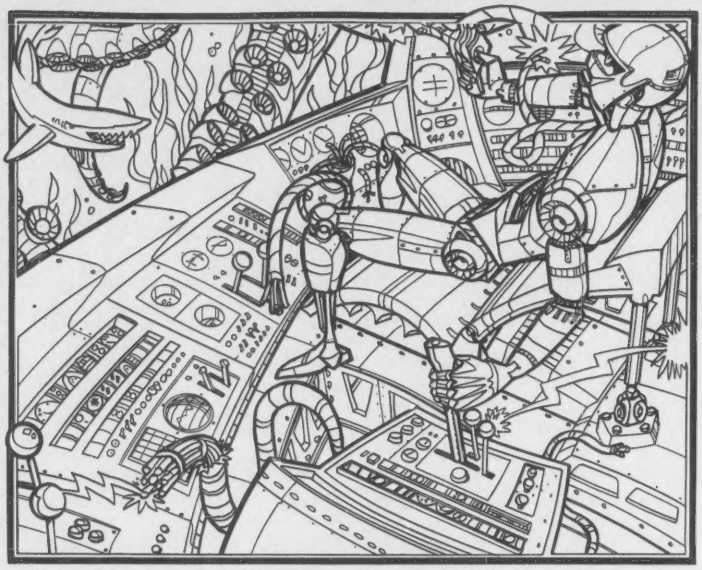
A problem-solving technique in artificial intelligence

Means-End Analysis

Norman Whaland



A principal goal of research in artificial intelligence is the development of programs that can solve a wide variety of problems. The programs aren't required to have comprehensive knowledge of problem solving. Rather, the information needed to solve each type of problem is supplied as data to the program, which contains general problem-solving techniques. The problem-dependent information can be supplied in much less time than would be required to write a special-purpose program.

General problem-solving techniques can be found by investigating the methods of human problem solvers. Oddly enough, psychologists have done little systematic work on this subject. Fortunately, anyone can search for problem-solving methods without training or special equipment. You simply solve a problem, note the method you used and generalize it.

Let us begin, then, by solving two algebra problems. We will abstract from the solutions a general method, called **means-end analysis.** Finally, some of the programs that use means-end analysis will be described.

A Simple Problem

Consider **expressions** formed from the symbols A, B, C, +, -, (, and). Typical expressions are A, (B-C), (B+B)-A and (A+B)+C. The minus sign is used only as a binary operator: -B is not an allowable expression. An expression other than a single letter must be enclosed in parentheses if it forms part of a larger expression. Thus, A+B+C is not an allowable expression.

Expressions are manipulated by the **transformation rules** listed in Table 1. The variables U, V and W stand for expressions. For example, substituting (A-B) for U and C for V in Rule 1 gives the transformation

(A-B)+C → C+(A-B).

A rule can be applied to a subexpression. Thus, Rule 1 can be used to transform (A+B)-C into (B+A)-C.

1	U+V → V+U
2	U+(V+W) → (U+V)+W
3	(U+V)-V → U
4	U → (U+V)-V
5	(U-V)+W → (U+W)-V
6	(U+V)-W → (U-W)+V

Table 1. Transformation Rules.

Norman Whaland, 430 E. 9th St., Apt. 15, New York, NY 10009.

This is the problem: to transform the **initial expression** (A+B)+C into the **target expression** A+(B+C), using only the transformation rules in Table 1. It's not quite as easy as it looks, because the rules provided are less powerful than the familiar manipulations of high-school algebra.

First, we determine the differences between the initial and target expressions. The most noticeable difference is that (A+B)+C has the parentheses on the left, while A+(B+C) has them on the right. Next, we look for a rule that removes the difference. Unfortunately, none of the rules move parentheses from left to right. Can we find other differences?

General problem-solving techniques can be found by investigating the methods of human problem solvers.

Instead of taking a global view of the expressions, we can look at the individual letters. The letter A is inside the parentheses in the initial expression and outside them in the target expression. The letter C shows the opposite difference, being outside the parentheses in the initial expression and inside them in the target expression. The letter B is inside the parentheses in both expressions.

This time we do find a rule that can be used to eliminate the differences. Rule 2 moves U into the parentheses and W out of them, while leaving V inside the parentheses. By watching these changes with the movements of the letters in the problem, we can see that we must substitute A for W, B for V, and C for U. This gives us the transformation

C+(B+A) → (C+B)+A.

The rules provided are less powerful than the familiar manipulations of high-school algebra.

Before using this transformation we must transform the initial expression into C+(B+A). We have reduced the original problem to the two new problems

(A+B)+C ?→ C+(B+A) and
(C+B)+A ?→ A+(B+C).

The rationale is that the new problems should be easier to solve than the original, because the differences most difficult to remove are now gone.

The remaining differences are easily removed by repeatedly applying

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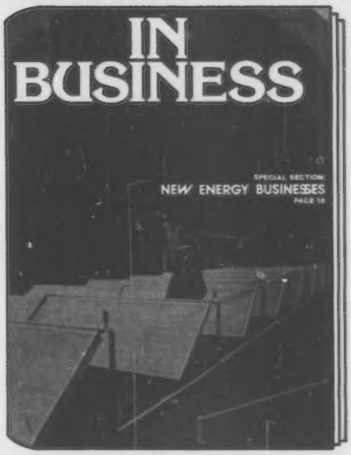

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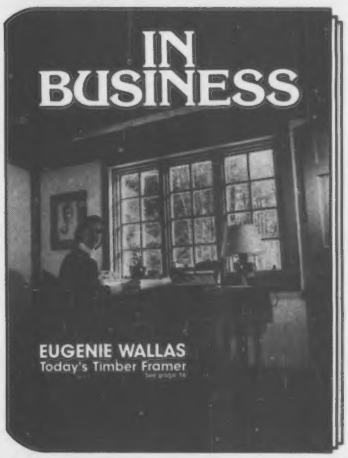

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Means-End, con't...

Rule 1. This gives us the complete solution

(A+B)+C
→ (B+A)+C (Rule 1)
→ C+(B+A) (Rule 1)
→ (C+B)+A (Rule 2)
→ A+(C+B) (Rule 1)
→ A+(B+C) (Rule 1)

Means-end analysis was helpful in solving the problem, but not essential. A blind search also succeeds fairly quickly, because the repeated application of Rules 1 and 2 to the initial expression produces only 11 distinct expressions. Our next problem, however, can only by chance be quickly solved by blind search.

A Difficult Problem

The problem

(A+C)-(B+C) ?→ A-B

(using the same list of transformation rules) is much more challenging. Quinlan and Hunt (1968) posed it to several graduates in mathematics, engineering and computer science, and not all of them were able to solve it. Nevertheless, it can be solved in a few minutes by thoughtful application of means-end analysis.

As before, we first look for differences between the two expressions. The most obvious difference is the presence of two C's in the initial expression. Obviously, Rule 3 will have to be applied at some point. If we substitute C for V and (A-B) for U, we obtain the transformation

((A-B)+C)-C → A-B.

Thus, the original problem can be reduced to the problem

(A+C)-(B+C) ?→ ((A-B)+C)-C.

We have reached a point where it is easy to go astray. It appears at first glance that all we have to do is move letters around, using Rules 1, 2, 5 and 6. A close look at the remaining differences saves us from this error. Notice that -B and -C appear in the target expression but not in the initial expression. None of the rules just mentioned can change the sign of a letter.

In the target expression of the original problem, -B is the only negative letter. Perhaps applying Rule 3 first has made the problem more difficult. In any event, it is now clear that we must apply Rule 4, the only rule that can introduce a negative letter.

Rule 4 can be applied to the initial expression of the original problem. The difficulty lies in choosing the best of the many ways of applying it. Clearly, we want to substitute B for V. It seems reasonable to substitute a letter for U, to keep the expressions as simple as possible. Under these restrictions Rule 4 can be applied in four ways, yielding these transformed expressions:

(((A+B)-B)+C)-(B+C)
(A+((C+B)-B))-(B+C)
(A+C)-(((B+B)-B)+C)
(A+C)-(B+((C+B)-B))

Now we have to decide which expression is easiest to transform into A-B. In the second expression the letters to be eliminated appear as (C+B) and -(B+C) — almost what is required to apply Rule 3. Therefore, we take it as the starting point for further transformations.

We might as well begin by applying Rule 1 to the expression (C+B), giving us

(A+((B+C)-B))-(B+C).

This expression is to be transformed into

((A-B)+(B+C))-(B+C)

so that Rule 3 can be applied. The two expressions differ only in the positions of the subexpressions A, -B, and (B+C). This fact suggests a strategy for completing the solution.

We will apply to (A+((B+C)-B) the rules for moving expressions — Rules 1, 2, 5 and 6 — taking care to avoid breaking up the unit (B+C). Means-end analysis is no longer needed, since only one sequence of transformations is consistent with the strategy. For example, only Rule 1 can be applied initially, giving (((B+C)-B)+A). Then only Rule 5 applies. Proceeding in this way, we obtain the complete solution:

New problems should be easier to solve than the original, because the differences most difficult to remove are now gone.

(A+C)-(B+C)
→ (A+((C+B)-B))-(B+C) (Rule 4)
→ (A+((B+C)-B))-(B+C) (Rule 1)
→ (((B+C)-B)+A)-(B+C) (Rule 1)
→ (((B+C)+A)-B)-(B+C) (Rule 5)
→ ((A+(B+C))-B)-(B+C) (Rule 1)
→ ((A-B)+(B+C))-(B+C) (Rule 6)
→ A-B (Rule 3)

A Problem-Solving Procedure

The way in which the problems were solved suggests the outlines of a general procedure. Suppose that we are given a problem formulated in terms of an initial expression, a target expression and a list of transformation rules. The expressions needn't be algebraic and could, for example, be statements in a formal language. Then a solution can be sought with the following system:

1. Find the differences between the two expressions.
2. Select the difference that is likely to be the most difficult to remove.
3. Select a rule appropriate for removing that difference.
4. Determine which expressions to substitute for the variables in the rule.
5. If the resulting transformation doesn't solve the problem outright, determine its relationship to the given expressions in the projected solution.

Only one sequence of transformations is consistent with the strategy.

6. Place the resulting one or two new problems on a list of pending problems.
7. Choose a problem from the list and return to step 1.

The procedure can be elaborated in various ways, some of which we saw in the examples. When the choices in steps 2 through 5 are difficult, we might try all reasonable possibilities and choose in step 7 the new problem that looks easiest. Looking for differences can be omitted when only one transformation applies to the initial expression. Finally, choices can be limited by selecting a strategy, as in the second example.

The key feature of means-end analysis is that the differences between the initial and target expressions guide the choice of transformation rule. Consequently it is more likely to lead to a solution than the choosing of a rule merely because it can be applied to the initial expression.

Computer Applications

Because means-end analysis is applicable to a wide range of problems, and because it allows the separation of the general method from the information for particular types of problems, it has often been used in problem-solving programs. The first such program was the General Problem Solver (GPS) by Simon, Newall and Shaw in the late 1950's. It follows a procedure more complicated than the one just outlined — for one thing, several types of problems can appear on the problem list — but the basic principle is the same.

GPS has been able to solve a variety of simple puzzles and algebraic problems. The program proper is quite general. Data structures specify the information needed for a particular class of problems — information such as the definitions of the differences, the priorities for reducing differences and the transformations appropriate for each difference.

Means-End, con't...

Unfortunately, specifying a problem to GPS often takes longer than solving it by hand. Though not a practical problem solver, GPS is instructive and has inspired improved programs. Quinlan and Hunt's (1968) Fortran Deductive System (FDS) has a fixed set of differences and therefore is easier to use than GPS, but less versatile. It solved the problems in this article in five seconds and 169 seconds.

The key feature of means-end analysis is that the differences between the initial and target expressions guide the choice of transformation rule.

Perhaps the most important successor to GPS is STRIPS, the Stanford Research Institute Problem Solver (Fikes and Nilsson, 1971). It finds the differences by an ingenious and widely applicable method. The structure to be transformed is not represented directly, but is specified by a list of its properties, expressed in the language of formal logic. A theorem-proving routine in STRIPS tries to prove that the problem has already been solved. If it fails, the uncompleted proof is used as the difference. The relevant transformations are those that, if successfully applied, would enable the theorem prover to continue the proof. The program was designed to produce plans of action to guide a robot. Nevertheless, its methods seem powerful enough for the kinds of problems FDS and GPS have solved.

All these programs have difficulty finding solutions with many steps, because the number of possibilities tends to increase rapidly with the length of the solution. The ABSTRIPS program (Sacerdoti, 1974), a modification of STRIPS, is designed to overcome this problem by sketching the outlines of a long solution before filling in the details. It tries first to find a sequence of transformations that deals with the differences most difficult to eliminate. Transformations are used even if they aren't applicable, provided that the fault can be remedied by removing lesser differences. The gaps in the solution are then filled in by stages, in which successively easier differences are eliminated. By tackling the hard part of the problem first, ABSTRIPS avoids wasting time filling in details of solutions that can't be completed.

Means-end analysis has wide application in problemsolving. Conscious application of the method can be helpful in solving difficult problems.

Conclusion

Means-end analysis has wide application in problem solving. Conscious application of the method can be helpful in solving difficult problems. Programs using means-end analysis have had some success, but further work is needed to develop its potential.

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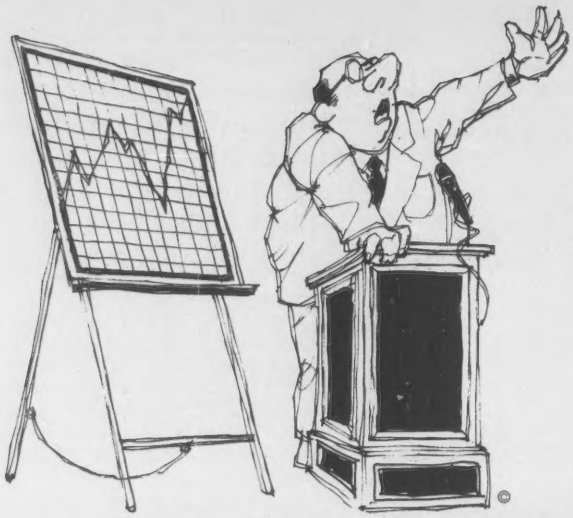

Donald E. Knuth Speaks Out

Winner of the 1974 Turing Award and author of the definitive series, **The Art of Computer Programming**, Donald E. Knuth is currently involved in a project in mathematical typography. This project has two major thrusts: one to use the computer as an aid in typesetting. Professor Knuth has designed a new language, TEX (an acnomym for Tau Epsilon Chi), to overcome problems in existing computerized typeset systems, particularly with mathematical formulae. The second aspect of this project is to use the computer to help design new typefaces with another new language, Metafont. An interesting conclusion from this aspect of the project is that a small amount of randomness applied to "perfect" letter design frequently makes the type more pleasing to the eye. Professor Knuth believes that Gutenberg's invention of movable type, significant as it was in its day, has little relevance for the future and, indeed, it affected history for only about 500 years. The future of typesetting and publishing is with computerized photo-digital type.

Professor Knuth is a strong believer that progress is a result of the application of many small ideas rather than one large one. He believes that large ideas are plentiful but that many people do not have the patience and persistence to apply the many thousands of small and frustrating steps to bring the original idea to successful fruition. He also feels that there are plenty of problems in numerous practical areas that could benefit from the application of computer technology coupled with applied mathematics and logic.

Following his presentation at the inauguration of Brown University's computer science department, I had the opportunity to chat with Don Knuth about macro and microcomputers, good programming, computer games and more. — DHA

At Don Knuth's presentation at Brown University a slide jammed. The projectionist took out the tray and turned it over to see what was wrong. Needless to say, the other 79 slides spilled out. Here, the slides are being painstakingly replaced.

Dave: You made the remark several times that it is a collection of small things that leads to interesting and significant new developments, as much as the one revolutionary breakthrough idea. What do you think the effect of all of these micros in the hands of hundreds of thousands of kids is going to be? Will something be achieved?

Don: Certainly the enthusiasm, and the more people thinking about these things, the more likely someone in the art will have really big ideas. For example, I recently drove my son to his birthday party, which was at the San Francisco-Giants game, with all his friends in the car and they were all talking about microcomputers. Certainly quite different from anything that we would discuss when we were in 8th grade. I don't think any of them are in high school yet. They seem to know more about it than I do, it's very surprising. Microcomputers give me all kinds of different feelings that I like. I'm glad to see the enthusiasm out there but I also sometimes get distressed when I read Byte magazine and can see people rediscovering the wheel and not knowing anything that went on ten years ago and not caring. I do feel, also, a loss of continuity with the past. Microcomputers are new. Still, they are very similar to macrocomputers about which a lot has been known so it's taken awhile for people to realize that there are also good things to learn from the older generation like me. Everybody feels that way when working with something for a long time, and he then sees a lot of other people coming in. You don't expect that everyone is going to see things exactly as you do. I am a little distressed at the lack of historical consciousness. I really believe it adds a lot to computers to see how the human element is involved and the way people now, with all their good ideas, will be able to build on the past a lot faster, if they know a little more about the past. They tend to also drop out of everything else and concentrate too Much on micros because they are so exciting they would rather do that. My pet peeve is that nobody knows how to spell mnemonic, nobody

Donald E. Knuth, Stanford University, Stanford, CA 94305.

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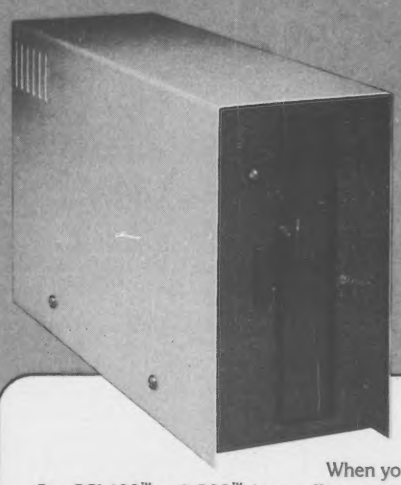

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Speaks Out,con't...

knows how to spell implement, but mnemonic is the worst. We went to an open house at a high school in Palo Alto to demonstrate the different elements of high school last year. One demonstration of the work in foreign language programs and studies was really exciting. They can study Arabic now as well as French. There were excellent programs about developing countries and what I consider important to learn about the culture of the world. Then we went to the next building where we saw a Social Studies selection. They had a demonstration of computer games. Some of these games are obviously done with a lot of devotion and enthusiasm, but the games were completely illiterate. The indication is that there is absolutely no connection with culture; the instruction says "congradulations" (spelled incorrectly) and the grammar is poor. This disturbs me...that computers are going to be associated with the loss of culture, even though they can really be the way to enhance our intellect. That's one of the negative things I feel about everything, all my other feelings are positive. It's really mind boggling how the machines we have now are so much bigger than any I played with when I first went into it.

Dave: I felt that when I was learning to program on an IBM 650 and Bendex G15's...you had 4K of usable core. The first minis, PDP5s and 8s, were again 4K, and to go to 8K was like having the world. I have kids working for me today who feel that if it doesn't have 48K you can't do anything with it.

Don: The IBM 650 was also comfortable because it was decimal, and when I first started with binary, I don't understand why, but it seemed that 650 had about 40 machine language instructions on it that you could use. The 709 had 250 but you never had the right one, on the 650 there always seemed to be the right one. The other thing I wanted to mention is games. Obviously, a fantastic reason for most people to use computers is to play games on them. This has been true on all levels of society. My friends at Tymshare Inc. told me that they studied just for fun once to see how many people were playing chess on their computer. They found hundreds of copies of Greenblatt's chess program under different names, they are never called chess, it was always some production type name. But they could recognize the program and they realized that they were in the business of selling games to maybe 30% or 40% of their users. This couldn't happen if it wasn't filling a real need. Traditionally espoused values say that games are frivolous. I think that this phenomenon can only be explained by saying that there is a need here that isn't being filled and actually you must consider games to be useful in spite of the fact that society doesn't traditionally accept this.

Dave: The use perhaps being finding a willing opponent or someone who isn't going to criticize your style of play?

Don: Or to enhance the quality of life. Sometimes you say why is building a bridge more important than something else? Well, you say, if you build a bridge, then you can cross the bridge and enjoy yourself. But why not enjoy yourself instead of building the bridge? What is the real goal of life? Well that's a real complicated philosophical question but one that you must consider somehow. Enjoyment should be considered as useful. The founder of Utilitarian philosophy, Jeremy Bentham, included it as a useful thing, but that seems to have dropped out of people's feeling as to what is useful. Obviously if you sit all the time and just use drugs and smile, it

doesn't seem very useful. You can carry anything to extremes. But I think we have gone too much to the other extreme to where we consider it really sort of pointless to enjoy ourselves. On the surface that is what we espoused. The fact is that the great interest in computer games has to tell us that our values have slightly gone down.

Dave: I'm glad you don't feel like so many other people do, particularly teachers in seconday schools, that games are horrible and useless and yet we come out with a new games book and we sell thousands of copies.

Don Knuth talked to a rapt audience about his new mathematical typography language.

Speaking of teachers in schools, a lot of attention is sometimes paid to programming style and efficiency yet someone atIBM recently came up with a figure of the cost to program one line of code compared to the cost to execute; it was a 3 billion to 1 ration. The implied meaning of that was well, really we should be paying attention to well documented code, programs that can be easily modified, ones that you know next week what you did this week, rather than looking to the ultimate efficiency.

Don: There are two reasons for efficiency. One is if you are executing a code 3 billion times, which is reasonable, in fact you can program a chess game and you are going to have parts of that which are done 3 billion times, there are a lot of combinatorial problems and things that it really pays to worry about. The other thing is just the pleasure of it. I discussed this question of style in a lecture I gave on computer programming as an art. In order to enjoy what you are doing, in order to enjoy computer programming you want it to be beautiful. You can say that your program is beautiful because it is well documented. You can say it is beautiful because it is efficient. You can say it is beautiful because of it's structure. There are many characteristics that you can't have all at once. You want it to be beautiful so you can enjoy what you are doing. So efficiency is something that many people enjoy saying, "I can do this efficiently and this gives me a lot of satisfaction and gives me the creative pleasure of writing a good program," If you don't have some-

Speaks Out, con't...

thing that you are optimizing, something to make it satisfying for yourself, then you don't have any style. I don't want to enforce a certain kind of style and say this is the most beautiful. What I want to stress is that style is important, what you find is right for you. It should be something you could take pride in. You can look at other people's programs and notice the style is distinquished just like musical styles. Some of them will appeal to you more than others. There is no universal style. You can also appreciate the person who has a real flair for something and get pleasure from reading somebody's program as well as writing one of your own.

Dave: Changing the subject—you apparently interrupted the production of your seven volume set to go off on the mathematical typography, when do you expect to resume publication.

Don: I expect to be done approximately three years from when I start, which is next April.

Dave: We are all looking forward to it. □

Three of the planned seven-volumes of The Art of Computer Programming are now in print. All three are available from Creative Computing Book Service for the price of the book plus $1.00 shipping for one book or $2.00 for two or more. Send order and payment to Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

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THE COMPUTER ROOM

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Historians will probably view the information revolution which is happening today as more important than the industrial revolution.

Interview With William Wulf

Betsy Staples

Staples: Can you tell me what you do at Carnegie-Mellon?

Wulf: I am a professor of computer science and the immediate past acting department head; I'm on sabbatical this year. I always have trouble describing my research. I think of myself as an engineer and what I enjoy doing is building things.

How can microcomputer technology be used to produce the equivalent of a very large, very powerful computer at one-tenth the cost?

Areas that interest me are the interface between hardware and software; sometimes I come at that interface from one side and sometimes from the other. I design languages, machines and operating systems. What I most enjoy doing is designing, building them, putting them out for people to use, watching the users, and trying to understand what happens. Some of them have been reasonable successes.

I designed Bliss, which is now the system implementation language used by DEC. I also designed the optimizing compiler strategy that's used by many large compilers now. I'm now studying to see if it's possible to automatically generate highly optimizing compilers and, given a formal description of the computer, see if one can produce a complete compiler automatically or at least the code generation and optimization phases of it. That's a fairly significant economic project because such a compiler may now cost anywhere from one-half to $10 million. I've also been involved in the design of computers like C.MMP.

Staples: What is C.MMP?

Wulf: C.MMP is the short form for describing a computer which is a multi-processor, and in particular a multi-miniprocessor. There are 16 PDP-11's which are connected to a shared memory, which right now is about two megabytes, but it could, in principle, be up to 32 megabytes, and there's a single operating system controlling the whole collection. Any processor can access any of the memory any time. So when a user logs into the system he doesn't know which processor he is using and his job may, in fact, move around from one processor to another during the course of the execution. In fact, it may change every few milliseconds.

It is one of two attempts--we have another machine called Cm* which has 50 LSI-11 processors and again share a common memory, although they access it in a different way. Both projects are attempts to understand how one can use small computers which are economical--to get the power of a big machine.

C.MMP is roughly the power of a CDC 6600, but it's much, much cheaper. When we started, we were really looking forward to the advent of the microprocessor. We started back in 1971, so its an old project at this point. But the question is: all right, now that we can build microcomputers by the wheelbarrow load, how can one use that technology to produce the equivalent of a very large, very powerful computer? And do so at one-tenth of the cost?

Staples: Do you have any observations in general on what's being done to make it easier for people to deal with computers?

Wulf: Well, several things. Average people are being exposed to more and more computers than they realize. Microprocessors are in your food processor, your laundry drier, the braking system of your car or the carburetor, and so on. That trend will certainly increase. There will be more and more conceptual ability, sensory ability and intelligence put into very prosaic products. There's no good reason why lights can't turn themselves out when we have left the room.

Staples: Do you think that kind of thing will be done by a central microcomputer system in the house or just something in the light switch.

Wulf: Which of those happens will be determined strictly by technology. If it's cheap enough to put the equivalent of an IBM 370/168 in the light switch for a nickel, then there's no reason to have a centralized computer in the home. You can do some pretty smart things with that kind of computing power. On the other hand, it's clear that communication ability is a major component of what's going on.

I expect to see a lot of distributed intelligence, and also a lot of communication with centralized data bases, for example. Although I don't want to have the Library of Congress in my house, I sure would like to have access to it.

Staples: During the panel discussion this morning, you mentioned computer hackers. You said it was a "respectable discipline." Do you think that there's a need for people like this?

I don't want to have the Library of Congress in my house, but I sure would like to access to it.

Wulf: The trouble is that the word "hacker" is so often pejoratively used that maybe I shouldn't have said that. What I had in mind was that if you were to come to Carnegie-Mellon, for example, and use our computer, you would find that a large percentage of the useful programs that we use every day and have become an integral part of our environment were not supplied by the manufacturer--they were written by somebody who was testing out an idea and the idea proved good enough to turn it into

Wulf/Staples, con't...

something that could be used on an everyday basis.

Staples: What sort of programs?

Wulf: The editors, the document production system, the system that we use for sending mail and memos back and forth over the computer. Almost all of the programming languages that we use, for example, were not developed by the manufacturer. I'm not saying they were all done at Carnegie-Mellon; some were done at other universities with similar equipment. Except for the operating system, we use almost nothing that came from the manufacturer. It almost all came from somebody hacking around.

That's not to say that every program which gets hacked is good. On the contrary, there are scores of them that aren't any good. However, the individual learns something from doing it. They usually are doing it because it's different in some way. They don't like the way the existing facility works. They think it's better to try it some other way, so they try it and maybe they're right, the program evolves over a very long period of time and ultimately turns into something a little bit different than the original image. But that's all very good and very productive, and I think it is sort of universally true.

Staples: Do you have any advice that you would offer to a young reader? What direction would you take in computing now if you were starting over?

A high percentage of our most useful programs at Carnegie-Mellon came from somebody hacking around.

Wulf: Someone mentioned that many of us are almost messianic about this, and I guess I fit that picture. Right now is an incredibly important time. I think that when historians look back one or two hundred years from now, they are going to identify this time as a revolution which is more important than the Industrial Revolution. We are talking about an Information Revolution. The Industrial Revolution basically allowed us to amplify our physical powers and accomplish things that we couldn't with our hands. What is happening now is the analog of an intelligence revolution, an information revolution, and what the machines are letting us do is a bunch of things that we, as individuals, couldn't do with our Heads. That's so much more important than just doing physical things. So, to your young readers: get involved. It's the most exciting thing that's happening. There's nothing else as important. From a pragmatic point of view, certainly go to college. We are talking now about something which is turning into a science. It appears, perhaps, to the amateur that it's something that's easy to get into when anybody can learn how to wire together a microprocessor with some memory and put a keyboard on it. Anybody can learn to program, but that's not what computer science is all about. Those are just some very basic tools; you really still need an education. Education along with the entire computing field, is evolving very fast. Get involved! □

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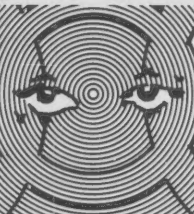
Looking To The Future

Some practical observations



Tim Scully, Ph.D.

The availability of very inexpensive and powerful microcomputers is sure to have tremendous impact over the next 20 years. Although it isn't possible to predict all of the changes computers will bring to our lives, I'd like to at least discuss a few possibilities which may develop.

It would also be easy to provide an "on line" computer dating service or a car pool service through a community bulletin board system.

You've heard of "the information explosion" and it appears we are drowning in a rapidly expanding sea of information. Books, magazines, professional journals and other publications are churning out at an ever-increasing rate. The day of the Renaissance Man, who was able to keep up with all new developments, is now past. Over specialization has locked us into tiny compartments of knowledge which are often cut off from each other.

A National Data Base

Now imagine what it might be like to "fly" through the field of all available information and "land" on the facts relevant to any problem. It is conceivable that the contents of the Library of Congress could be put into a national data base, continually updated by new publications. Every citizen could tap this data base via a home computer and either a telephone link or perhaps the cable TV network (the information capacity of a cable TV line is much greater than a telephone line).

You might sit at your keyboard, type a list of keywords to describe your area of interest and begin reading text as it scrolls on your video monitor. A joystick under your right hand controls the display. Pushing it away from you slows the scrolling or stops it, pulling the joystick toward you speeds the display. Tipping the stick to the right causes the information to become more summarized so that you see only major topic headlines or indices, while tipping the stick to the left causes more detail to be displayed so that eventually you progress from the titles of works to abstracts and then to the row text.

You could place standing orders through your computer so that you'd be notified of any new publications in your area of interest. By careful choice of keywords, you could learn of publications in specialties remote from your own which contain ideas useful to you. Such cross-fertilization of ideas would be only one of the benefits of a national data base.

You could ask to be instantly notified of any pending legislation which might involve issues of importance to you. If your computer signals that an important legislative debate will take place on a law affecting your job or community, you may choose to sit down at the keyboard and text-edit a brief message to your legislator, indicating your opinion and interest in the matter. This feedback could be analyzed by your legislator's office computer to maintain a closed feedback loop between citizen and government. When election time rolls around, it would be very easy for you to request a printout of your candidate's voting record on every issue of interest. You could easily compare this to an earlier list of campaign promises, also stored in the data base.

It might be possible for a new form of publishing to be implemented through the national data base. An author could submit a work to the data base with a tag attached which would cause the reader's account to be billed for a modest fee if the document is accessed by the reader's home computer. The fee might be low for video screen access and somewhat higher if a hard copy of the work is created.

Computerized Communications

In case all of this seems far off in the unlikely future, I'd like to tell you about some of the related developments which are happening now. Digicasting, for example, is now in the experimental stage. This technique involves the transmission of digital data via a subcarrier on either a television or FM radio station. The digital data may be news, advertising or any other form of information. If your home computer is hooked up to a receiver, you may be able to program it to select the items of interest to you.

Suppose, for example, that you'd like to buy a used car, that you have between $1,000 and $1,500 to spend and that you'd like a Volkswagen. You could ask your computer to search all incoming ads for anything meeting these criteria. This would save you a lot of searching and reading of uninteresting ads. The advertisers will be more sure of reaching interested buyers, yet this form of advertising should be quite inexpensive. The rate at which digital data may be transmitted is much faster than conventional speech or reading; many ads could be transmitted every minute.

You've heard of "the information explosion" and it appears we are drowning in a rapidly expanding sea of information.

Community computer bulletin boards are a related development. These consist of a computer with a lot of mass storage and with one or more modems for telephone data exchange. You may use your home computer and telephone to either explore the messages and ads left on the bulletin board, or you might leave a message or ad yourself. This can be a nice way to run a flea market, find a home for rent, learn about club meetings and more.

Imagine such a bulletin board being used by postage stamp collectors. Each collector could list the

Tim Scully, Ph.D., PO Box 175, Albion, CA 95410.

Observations, con't . . .

stamps available for trade and the stamps desired. A computer search could turn up the names of folks with complementary desires. It would also be easy to provide an "on line" computer dating service or a car pool service through a community bulletin board system.

While the cost of home computers has been dropping, you might still argue that many folks will not have access to computers for many years to come. I don't think this will be true. Computers are already appearing in many schools and some grammar school students are already learning how to write programs. I expect to see computers in public libraries, perhaps coin operated in much the same way photocopy machines are. Timesharing companies are already offering very inexpensive access to their networks, I saw a recent ad quoting $8 per hour. It is worth noting that some of these networks cover vast geographical areas.

There have been some experiments with conferences held via computer network. Participants may be scattered around the world but are linked to a central computer. Each may deposit messages in the computer, addressing each message to the entire meeting, to a committee, to a special interest group, or to an individual. This turns out to be a surprisingly effective communication technique. As the cost of energy for transportation goes up, we may see more innovative use of computers in communications. A large percentage of the folks who now commute to an office where they handle paperwork may be able to simply sit down at their home terminal and do the same job.

Computer models are never even as good as the data fed into them. A model is, of necessity, a simplification of the incredible complexities of a real-life system.

Computer Modelling

It is now difficult and complicated but possible to construct computer models of systems. An airplane may be modelled on a computer and "test flown" before it is actually built. In the same way, economic, social and ecological systems may be modelled. The effects of proposed legislation, new industry or other changes may be evaluated with the help of the computer model. Possible effects of such changes may be projected months or years into the future to aid intelligent decision-making.

Of course, it is important to remember "Garbage In, Garbage Out." Computer models are never even as good as the data fed into them. A model is, of necessity, a simplification of the incredible complexities of a real-life system. But there is reason to believe that it will become easier to build more accurate computer models in future years, and eventually it may become so easy that the average citizen can use modelling as an aid in making personal decisions. The trend toward increasingly powerful high level computer languages may eventually lead to a language in which such modelling would be very easy. With the aid of a national data base, it might become possible to improve model accuracy by taking into account more factors influencing the real-life system.

I'm sure that I haven't begun to scratch the surface of this topic. The future of inexpensive computers is limited primarily by our imagination. As the next generation grows up learning one or more computer languages in grammar school, we should expect truly startling developments. □

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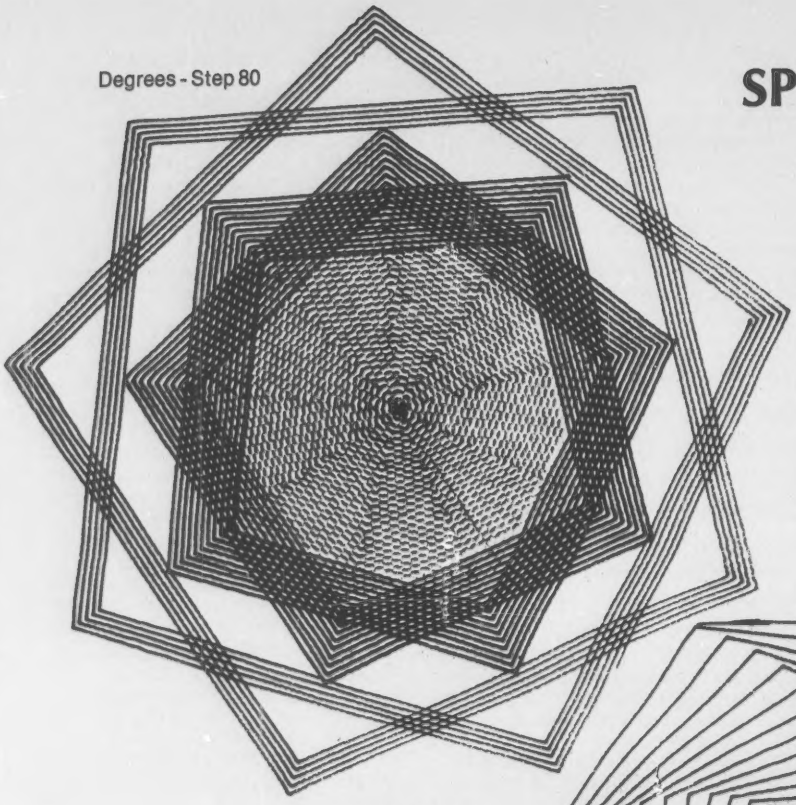
SPIRAL DESIGNS

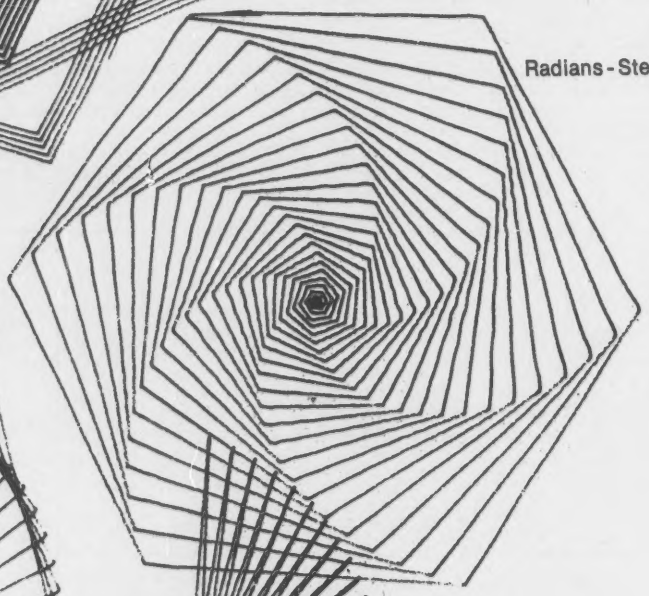
David Lomartire

The graphics designs on these pages were done on a Hewlett-Packard Model 9100 calculator and Model 9125A plotter. All are based on a spiral except the one marked with an asterisk (*). This one is a circle, done in radians, with a radius of two and an angular step of 110. S in x (the x value) and cos x (the y value) are plotted.

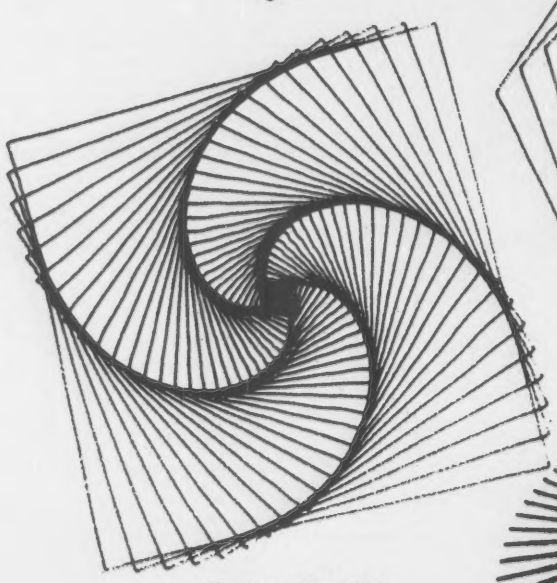
The other designs, based on a spiral, all have a radius increase of 1/72 and an angular increase which is expressed on each design. The plotting was done in polar coordinates and the equation plotted was (r,0) where the increases have already been expressed.



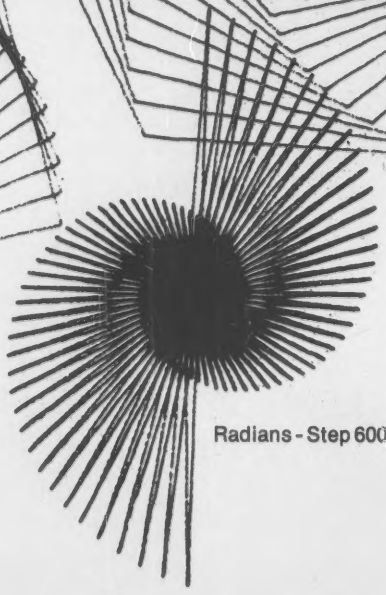
Degrees - Step 80



Radians - Step 200

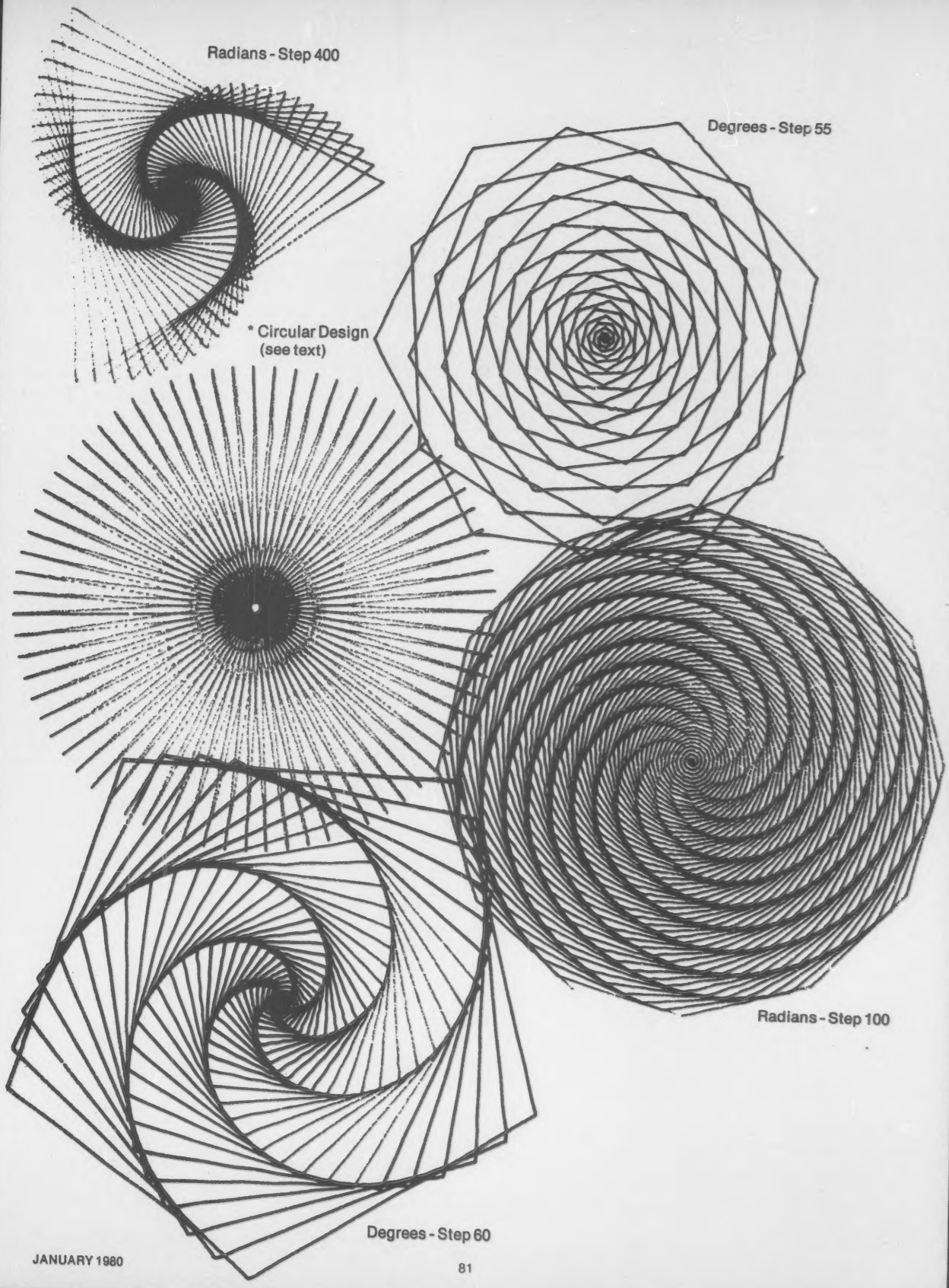


Radians - Step 300



Radians - Step 600

David Lomartire, 34 Burr School Road, Westport, CT 06880.


Radians - Step 400
Degrees - Step 55
* Circular Design
(see text)
Radians - Step 100
Degrees - Step 60

RND
Frequency Graphs

David Gerrold

Thom Ronayne's article, "Random Thoughts on RND" started me thinking about frequency responses. If you could generate a curve for different values of RND, you would better be able to judge which one best suits your needs.

The enclosed program and a sample run are the result of that thought. Although this run is for a small sample, I let the Northstar do some samples of 10,000 trials per graph overnight and achieved generally the same curves.

For what it's worth, I've only had the micro for a week, only been learning how to use it this past week (but in long shifts of sometimes as much as 12 hours a day) and have come away from it convinced that programming is a subject that needs to be demythologized. My non-computer friends think it's an arcane complicated subject. I see them (now) as illiterates because there's a tool that they are refusing to learn how to use. Programming this little wonder has proven to be easier than I ever imagined it would be. And for the first time, it's a delight to use a machine whose limitations I have been unable to discover.

David Gerrold, P.O. Box 1190, Hollywood, CA 90028.

David Gerrold at a Star Trek Convention. Trekkies will recall that David was author of the highly acclaimed episode, "The Trouble With Tribbles." He also edited several other shows and wrote the story which became "The Cloud Minders" episode. He has edited three sci fi anthologies and written two books about Star Trek.

```
LIST

10REM----------------------------------------FILE NAME\ RANDOM
20!"SET NUMBER OF TRIALS: "\INPUTC1
30!"SET SCALE OF GRAPH.  DIVIDE BY: "\INPUT Q
35DIM N(20)
40FOR A=1TO6
50FOR S=-1TO0
60REM
70C=0
80GOSUB360
90N(X)=N(X)+1
100C=C+1
110IF C>=C1THEN130
120GOTO80
130REM-----------------------------------PRINTOUT
140!
150!"------------------------------------------------------------"
160!\!"FOR C=",C
170!"FOR S=",S
180!"FOR A=",A
190!\!
200FOR Y=1TO9
210!
220!"N(",Y,")=",N(Y),":  ",
230FORH=1TOH*N(Y)/Q
240!"*",
250NEXT H
260NEXT Y
270!\!"N(10)=",N(10),":  ",
280FORH=1TOH*N(10)/Q
290!"*",
300NEXT H
310FORZ=1TO10
320N(Z)=0
330NEXT Z
340NEXT S
350NEXT A
352!\!\!\!"TH-TH-THAT'S ALL, FOLKS!"
354END
360REM--------------------------------VALUES TO BE TESTED
370 ON A GOTO 380,400,420,440,460,480
380X=INT(10*RND(S)+1)
390RETURN
400X=INT(3.14159*RND(S)+1)
410RETURN
420X=INT(10*RND(0)*RND(S)+1)
430RETURN
440X=INT(10*RND(-1)*RND(S)+1)
450RETURN
460X=INT(6.2*RND(S)+1)
470RETURN
480X=INT(6.35*RND(S)+1)
490RETURN
```

```
RUN

SET NUMBER OF TRIALS:
?2500
SET SCALE OF GRAPH.  DIVIDE BY:
?20

--------------------------------------------------

FOR C= 2500
FOR S= -1        X=INT(10*RND(-1)+1)
FOR A= 1



N( 1)= 340:  *****************
N( 2)= 186:  *********
N( 3)= 278:  *************
N( 4)= 221:  ***********
N( 5)= 349:  ******************
N( 6)= 280:  **************
N( 7)= 136:  ******
N( 8)= 174:  ********
N( 9)= 142:  *******
N(10)= 394:  ********************
--------------------------------------------------

FOR C= 2500
FOR S= 0         X=INT(10*RND(0)+1)
FOR A= 1



N( 1)= 222:  ***********
N( 2)= 236:  ***********
N( 3)= 242:  ************
N( 4)= 251:  ************
N( 5)= 262:  *************
N( 6)= 276:  *************
N( 7)= 273:  *************
N( 8)= 255:  ************
N( 9)= 234:  ***********
N(10)= 249:  ************
```

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```
FOR C= 2500
FOR S= -1
FOR A= 2
```

X= INT (3.14159 * RND(-1)+1)

```
N( 1)= 961:  **************************************************
N( 2)= 755:  ***************************************
N( 3)= 686:  **********************************
N( 4)= 98:   ****
N( 5)= 0:
N( 6)= 0:
N( 7)= 0:
N( 8)= 0:
N( 9)= 0:
N(10)= 0:
```

```
FOR C= 2500
FOR S= 0
FOR A= 2
```

X= INT (3.14159 * RND (0) + 1)

```
N( 1)= 826:  *****************************************
N( 2)= 757:  ***************************************
N( 3)= 802:  *****************************************
N( 4)= 115:  *****
N( 5)= 0:
N( 6)= 0:
N( 7)= 0:
N( 8)= 0:
N( 9)= 0:
N(10)= 0:
```

```
FOR C= 2500
FOR S= -1
FOR A= 3
```

X = INT (10 * RND (0) * RND (-1)+ 1)

```
N( 1)= 825:  *****************************************
N( 2)= 462:  ************************
N( 3)= 326:  *****************
N( 4)= 308:  ****************
N( 5)= 189:  **********
N( 6)= 151:  ********
N( 7)= 124:  ******
N( 8)= 61:   ***
N( 9)= 41:   **
N(10)= 13:
```

```
FOR C= 2500
FOR S= 0
FOR A= 3
```

X = INT (10 * RND(0) * RND (0) +1)

```
N( 1)= 817:  *****************************************
N( 2)= 521:  ***************************
N( 3)= 348:  ******************
N( 4)= 234:  ************
N( 5)= 204:  ***********
N( 6)= 143:  *******
N( 7)= 110:  *****
N( 8)= 72:   ***
N( 9)= 34:   *
N(10)= 17:
```

```
FOR C= 2500
FOR S= -1
FOR A= 4
```

X= INT (10* RND (-1) * RND (-1) +1)

```
N( 1)= 663:  **********************************
N( 2)= 579:  *****************************
N( 3)= 516:  **************************
N( 4)= 164:  *********
N( 5)= 193:  **********
N( 6)= 149:  ********
N( 7)= 119:  ******
N( 8)= 30:   *
N( 9)= 85:   ****
N(10)= 2:
```

```
FOR C= 2500
FOR S= 0
FOR A= 4
```

X = INT (10 * RND (-1) * RND (0) +1)

```
N( 1)= 879:  *********************************************
N( 2)= 484:  ************************
N( 3)= 311:  ****************
N( 4)= 219:  ***********
N( 5)= 219:  ***********
N( 6)= 127:  ******
N( 7)= 151:  ********
N( 8)= 55:   **
N( 9)= 22:   *
N(10)= 33:   *
```

```
FOR C= 2500
FOR S= -1
FOR A= 5
```

X = INT (6.2 * RND (-1) +1)

```
N( 1)= 141:  *******
N( 2)= 973:  **************************************************
N( 3)= 219:  ***********
N( 4)= 234:  ************
N( 5)= 663:  **********************************
N( 6)= 236:  ************
N( 7)= 34:   *
N( 8)= 0:
N( 9)= 0:
N(10)= 0:
```

```
FOR C= 2500
FOR S= 0
FOR A= 5
```

X = INT (6.2 * RND (0)+1)

```
N( 1)= 443:  ***********************
N( 2)= 409:  *********************
N( 3)= 387:  ********************
N( 4)= 413:  *********************
N( 5)= 401:  ********************
N( 6)= 367:  ******************
N( 7)= 80:   ****
N( 8)= 0:
N( 9)= 0:
N(10)= 0:
```

```
FOR C= 2500
FOR S= 0
FOR A= 3
```

X = INT (10 * RND(0) * RND (0) +1)

```
N( 1)= 817:  *****************************************
N( 2)= 521:  ***************************
N( 3)= 348:  ******************
N( 4)= 234:  ************
N( 5)= 204:  ***********
N( 6)= 143:  *******
N( 7)= 110:  *****
N( 8)= 72:   ***
N( 9)= 34:   *
N(10)= 17:
```

```
FOR C= 2500
FOR S= -1
FOR A= 6
```

X = INT (6.35 * RND(-1) +1)

```
N( 1)= 515:  **************************
N( 2)= 431:  **********************
N( 3)= 364:  ******************
N( 4)= 320:  ****************
N( 5)= 489:  *************************
N( 6)= 255:  *************
N( 7)= 126:  ******
N( 8)= 0:
N( 9)= 0:
N(10)= 0:
```

```
FOR C= 2500
FOR S= 0
FOR A= 6
```

X = INT (6.35 * RND (0)+1)

```
N( 1)= 370:  ******************
N( 2)= 423:  *********************
N( 3)= 375:  ******************
N( 4)= 410:  ********************
N( 5)= 400:  ********************
N( 6)= 377:  ******************
N( 7)= 145:  *******
N( 8)= 0:
N( 9)= 0:
N(10)= 0:

TH-TH-THAT'S ALL, FOLKS!
READY
```

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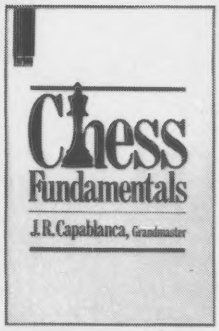

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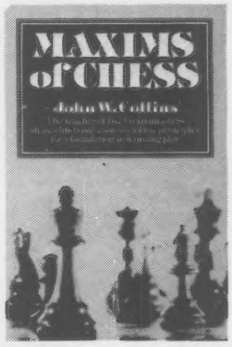

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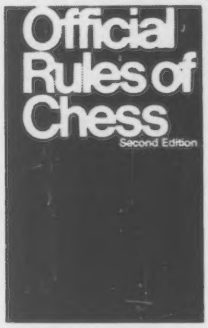

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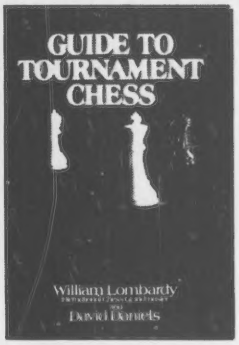

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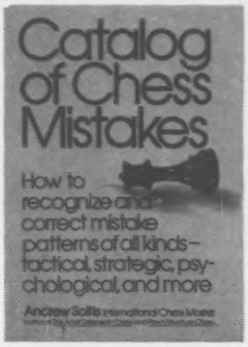

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The Computerized Resume

Douglas W. Green
Denise Thaler Green

Whether using a BASIC program or a word processing system, the importance of making sure all words are spelled correctly shouldn't be overlooked. — ED

The society of the 1980's will be, without a doubt, a fast paced and fast-changing world. The implications for job seekers and career changers are endless, but one aspect is clear: the individual who presents the most marketable package to the prospective employer will obtain the most desirable position. In the mid 1970's, approximately 300,000 executives changed jobs each year. Meanwhile, professional and technical employees changed jobs even more frequently.

The preparation of a personal resume is a necessary step in the pursuit of of greener employment pastures.

Add these people to the pool of college graduates seeking employment and a substantial number of job hunters results. Whether you are entering the job market or happily situated on the sidelines looking for that offer you can't refuse, the preparation of a personal resume is a necessary step in the pursuit of greener employment pastures.

With the use of a computer, the preparation and updating of one's resume can be greatly streamlined. This exercise can also serve as a simple, yet highly practical introduction to computer programming. The remainder of this article will present some general advice regarding resumes that anyone can use, followed by some tips on how to use a computer to prepare just the right resume for each prospective employer.

Douglas and Denise Green, Cortland Jr-Sr High School, Valley View Drive, Cortland, NY 13045.

A Resume For Every Job

The key to an effective resume is that it be tailor-made for the particular job. It must also emphasize the individual's unique skills and experiences as they relate to the job being sought. Without a computer, the task of designing the resume for each job can become a full time job in itself. For the person who is already employed but is always looking, the constant updating and retyping process has the potential of developing into a time-consuming, yet nontherapeutic hobby. This is especially true if the resume contains a goals statement or if you are planning a change in careers.

There are two approaches to resume writing that fit the two general classifications of people seeking employment. The most often used type is the chronological resume. This is the standard approach best used by people who have a number of years of experience which directly relate to the position for which they are hoping to interview. In addition to education and other personal information, this type of

The key to an effective resume is that it be tailor-made for the particular job.

resume simply lists the jobs the person has had in reverse chronological order. If you are satisfied that you are in the right career and are looking for a step up the ladder or just a change in scenery, then this is the approach for you.

Resumes For Beginners and Career Changers

If you lack experience that directly relates to the position for which you are applying, you certainly want to avoid advertising this fact. If this is the case, it is important to emphasize the skills you have acquired that will serve your new employer well and make him soon forget about your lack of experience. To do this, you need to use a skills-based resume. By listing skills first you show the reader how your talents fit his needs. If you do not do this, the reader may see your list of

If you lack experience that directly relates to the position for which you are applying, you certainly want to avoid advertising this fact.

experiences as being irrelevant to the position in question. Saying that you are skilled in developing and implementing small group instruction may be more impressive than saying that you served as a junior leader for the Boy Scouts. It also allows the young job seeker to list several skills that were developed during the course of one summer job. This can serve to make the resume appear more respectable without padding it. Sample headings that can be used in the two types of resumes are given in Figure 1, while Figure 2 shows a portion of a sample skills-based resume.

Sample headings for your resume

Chronological	Skills-based
Personal Data	Personal Data
Education	Skills Developed
Work Experience	Work Experience
Certification (licenses)	Education
Professional Affiliations and offices	Professional Affiliations
Publications	Certification
Other skills and interests	Publications
	Other skills and interests

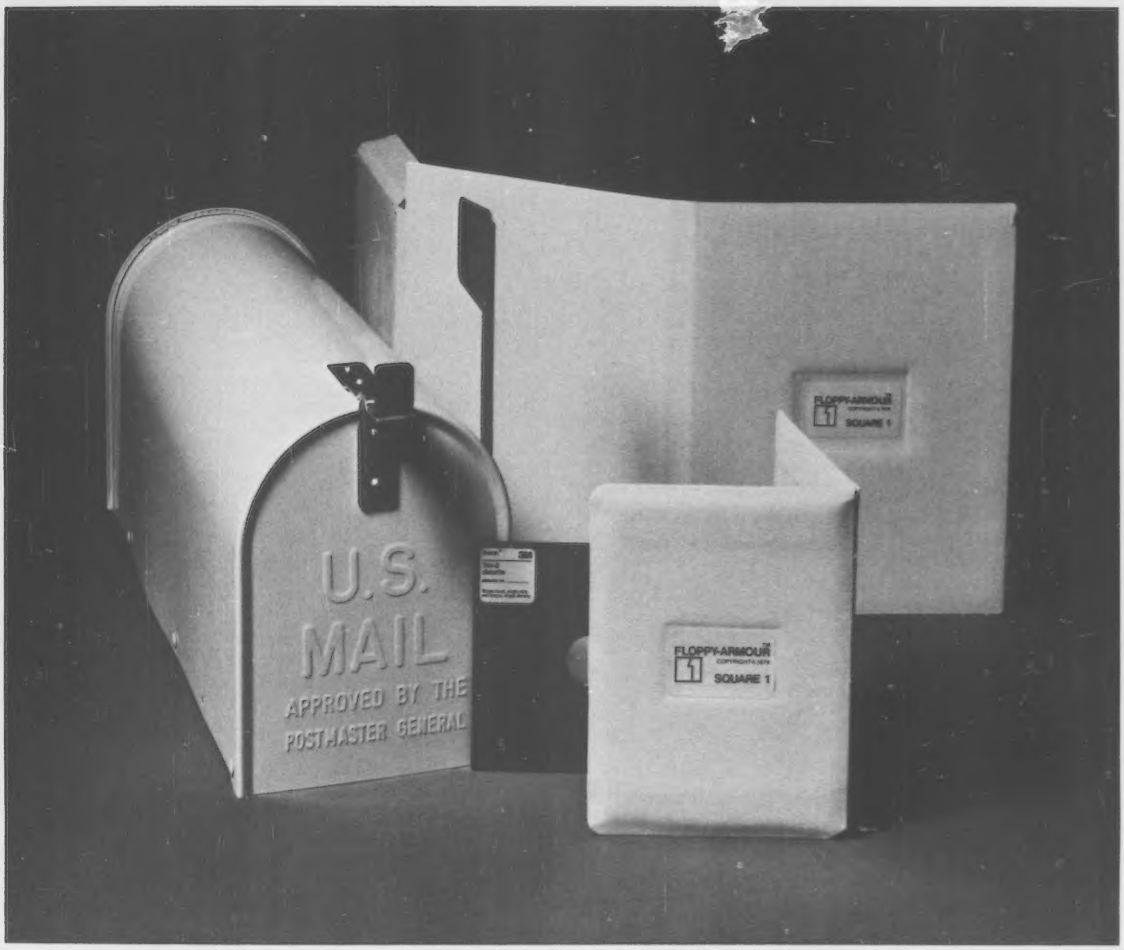
Suggested subheadings for a skills-based resume

administrative	communication
managerial	problem solving
financial	learning
computer	research
social skills	resource location
instructional	persuading
writing	coping with pressure
speaking	personal relations

skills related to knowledge of specific subject matter

Figure 1.

When you want it
to get there



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CIRCLE 189 ON READER SERVICE CARD

Resume, con't...

Writing Your Program

Most programs consist of three basic parts: input, processing and output. A resume program, however, need only contain output statements and for this reason is a natural for the beginner. All one need know is how to use the PRINT statement, which is usually the first statement anyone learns in the BASIC language. In many respects, therefore, this is more aptly considered an exercise in word processing than computer programming. All we are interested in here is using the PRINT statement to arrange our output in the most desirable manner. In order to do this, one must also learn how to use the TAB statement. This statement tells the computer in which column the next character of output will be placed. For example, if you entered the statement:

```
10 PRINT TAB(13);
   "PERSONAL DATA"
```

the computer would move over to the 13th column before it started printing. Another important and simple skill is knowing how to skip a line between sections of your output by using a PRINT statement by itself.

Once you have written your entire program all you have to do is save it on tape or disk to have it available for making more copies or updating the information. The amount of core required for this type of activity should not exceed 8K. If it does, your resume may be too long. Remember, the prospective employer may have a large number of resumes to sort through, and you don't want to give him more information than he needs during the initial screening. If you are convinced, however, that you need more than 8K or only have a 4K system, your troubles are easily solved. You simply divide your resume in half and write it as two separate programs. Since there are no variables in your program, you need not be concerned with the techniques involved in program chaining.

Saying that you are skilled in developing and implementing small group instruction may be more impressive than saying that you served as a junior leader for the Boy Scouts.

Other Programming Concerns And Possibilities

When typing a given line of your output, it is important to keep track of the paper width. If a line is too long, the prospects of having portions of a single word appear on two lines increases while your employment prospects decrease. If your system has a CRT you should note how far you can go on it before a statement must end. When doing this, be sure to count any spaces included in your tabs. With careful spacing it is possible to include more than one line of output per statement. This, however, requires consideration of the maximum number of key strokes your system allows per statement. On the other hand, using a good word processing system will be a great aid in formatting and updating a resume. This approach will also eliminate the hassle of writing a BASIC program for the project. It is a good idea to use 8½ x 11 inch paper. The format can be horizontal or vertical as long as you provide the new boss with paper that can easily fit into his briefcase or filing cabinet.

One final advantage that must be mentioned stems from the fact that your computerized resume will definitely set your personal history apart from the competition. And don't fail to mention in your cover letter that you programmed it yourself. This is no time to be modest. Even if the job seems to have no direct relation to computers, at least for now, a self-programmed resume tells the future employer that here is someone who is intelligent, creative and conversant with the foremost tool our technological society has to offer. □

Your computerized resume will definitely set your personal history apart from the competition.

```
                    Administration

Prepared and conducted bi-weekly comprehensive patient care
conferences at Highgate Manor Nursing Home

Planned and coordinated a community skills program

Supervised student interns

Acted as liason between Highgate Manor Nursing Home and a
number of community and governmental organizations

Assisted in the administration of the Adult Basic Education and
High School Equivalency programs at Cortland-Madison BOCES


                    Instruction

Developed and implemented a program of small group therapeutic
instruction for a number of psychiatric patients in reading skills

Taught English, social studies, health, and home economics to
students who for reasons of health or behavior were excluded from the
regular programs at Cortland Jr.-Sr. High School

Taught English to eighth graders at Jamesville-DeWitt
Middle School

Developed the ability to diagnose and remediate reading problems

Work Experience

                Psychiatric Social Worker

Highgate Manor Nursing Home, Cortland, N.Y., May 1977 to present

Carry a caseload of 80 residents on the health related units
70% of whom are diagnosed as having various mental disorders

Obtain and update full social histories

Prepare for, lead, and write conference reports for
interdiciplinary patient care conferences

Meet with clients on a regular basisand conduct group therapy

Conducts in-service training and supervises student interns
```

Figure 2. A portion of the output of a skills-based resume.

References:

(1) Field, H.S. and Holley, W.H. Resume Preparation: An Empirical Study of Personal Managers' Perceptions. *Vocational Guidance Quarterly*, 1976, 24, 229-237.

(2) Bolles, R.N. *What Color is Your Parachute?* Berkeley, CA: Ten Speed Press, 1972.

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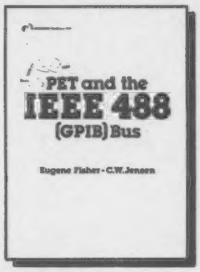

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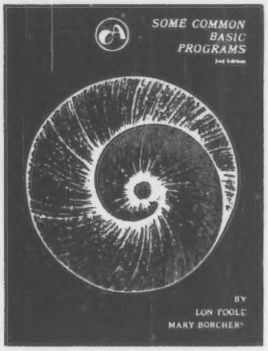

Some Common BASIC Programs

By L. Poole and M. Borchers

This book was designed for people who can use a variety of practical BASIC programs — 76 programs in all that cover a wide variety of personal finance, math, statistics, and general interest topics. The documentation in the book is complete so that you can run the programs even if you aren't an experienced programmer.

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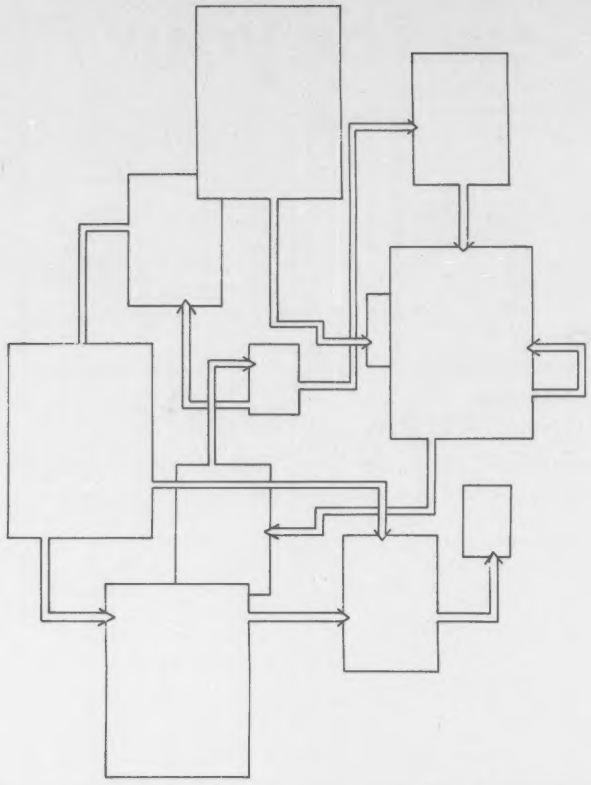

GROW:

A Program That "Learns"

Jeff Levinsky

One of the educational programs on the CHAOS II system (Ref 1 and 2) is a special extendable "game" named GROW. Based upon the well-known games of ADVENTURE and ANIMAL, GROW allows students to travel about in a vast world, learning about various topics while solving problems related to those topics. At any time, the students, as well as the teachers, may add new topics and questions to GROW, thus helping (or hindering) other who later explore the same route. In this context, GROW is as much a tool used to build CAI programs as it is a game.

One of the advantages of GROW is the speed and ease by which the things the program knowns about can be explored and extended. The basic framework can be built very quickly by a teacher and the task of filling in details (such as hints or paths to take to skip ahead to new lessons) can be added by students. A program which permits changes to itself is far more interesting than a standard interactive instructional system especially since the user's interactions may be preserved. This, of course, inspires and amplifies natural creativity.

GROW does not possess any artificial intelligence 'understanding' of either the subject matter or the user's interactions. Instead, simple pattern matching is used - but as the following sample session shows, this can be quite powerful in itself. The session begins with the user (whose input is in italics) invoking GROW from CHAOS II and trying some simple addition problems:

```
% GROW
WELCOME TO GROW
LEARN ADD
DO YOU WANT A DIFFICULT
 LESSON?
NO
SUPPOSE WE ADD 13 and -12.
 WHAT DO WE GET?
+1
RIGHT. SUPPOSE WE ADD -13
 and 12. WHAT DO WE GET?
+1
NO
-1
RIGHT
```

This standard pattern of GROW describing something (perhaps stating a problem) and the user then responding with a command or answer can be used far more imaginatively:

```
YOU ARE IN A DARK EERIE
 CAVE.
LIGHTS ON
THE CAVE IS NOW FILLED WITH
 GLARE- FREE FLORESCENT
 LIGHT. THERE IS A ROCK ON
 THE GROUND WITH THE MYS-
 TIC QUESTION: "WHAT IS
 THREE CUBED THRICE?"
19682
HUH?
19683
THRICE - NOT TWICE.
7625597484987
GOOD. THE ROCK VANISHES
 AND A GLISTENING METAL
 CYLINDER APPEARS IN ITS
 PLACE. THE CYLINDER IS
 ROUGHLY 6 INCHES HIGH
 AND TWO FEET ACROSS.
KICK IT
THAT MIGHT HARM IT.
SIT ON IT
THAT MIGHT HARM IT.
STAND ON IT
YOU HAVE JUST BEEN TRANS-
 PORTED TO THE STAR SHIP
 ENTERPRISE. YOU ARE ON
 THE BRIDGE. THE COMPUTER
 IS MALFUNCTIONING! IT
 DOES NOT KNOW WHAT THE
 SQUARE ROOT OF 3865156 IS.
ASK KIRK
HUH?
```

The scene the user is currently in can always be extended. In brief, the word EXTEND causes GROW to ask for

Jeff Levinsky, 2240 California St. #2, Mt. View, CA 94040.

Adventure

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This game was inspired by the huge Adventure game which has appeared on large mainframe computers the last several years. But there are important differences. Not only will **ADVENTURE** fit into a relatively small computer, but the 'interpreter' is designed so that different Adventures can be created by changing the data base. So look for more Adventures in the future...

In playing the game you wander thru various 'rooms' (locations), manipulating the objects there to try to find 'treasures'. You may have to defeat an exotic wild animal to get one treasure, or figure out how to get another treasure out of a quicksand bog. You communicate thru two-word commands such as 'go west', 'climb tree', 'throw axe', 'look around'.

Six Different Adventures

ADVENTURELAND (by Scott Adams) - You wander through an enchanted world trying to recover the 13 lost treasures. You'll encounter WILD ANIMALS, MAGICAL BEINGS, and many other perils and puzzles. Can you rescue the BLUE OX from the quicksand? Or find your way out of the maze of pits? Happy Adventuring.....

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PIRATE ADVENTURE (by Scott Adams) - "Yo Ho Ho and a bottle of rum..." You'll meet up with the pirate and his daffy bird along with many strange sights as you attempt to go from your London flat to Treasure Island. Can you recover LONG JOHN SILVER's lost treasures? Happy sailing matey.....

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ORIGINAL ADVENTURE (by Crowther, Woods, Manning and Roichel) - Somewhere nearby is a collosal cave where others have found fortunes in treasures and gold, but some who have entered have never been seen again. You start at a small brick building which is the wellhouse for a large spring. You must try to find your way into the underground caverns where you'll meet a giant clam, nasty little dwarves, and much more. **This Adventure is Bi-Lingual**—you may play in either **English or French**—a language learning tool beyond comparison. Runs in 32K CP/M system (48K required for SAVE GAME feature). Even includes SAM76 language in which to run the game. The troll says "Good Luck."

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CS-3009 TRS-80 16K Level II (Machine language)	$14.95
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CS-5005 SORCERER 16K (Machine language)	$14.95

VOODOO CASTLE (by Scott Adams) - Count Cristo has had a fiendish curse put on him by his enemies. There he lies, with you his only hope. Will you be able to rescue him or is he forever doomed? Beware the Voodoo Man.....

CS-3010 TRS-80 16K Level II (Machine language)	$14.95
CS-3507 TRS-80 32K Disk (Includes Mission Impossible)	$24.95
CS-5006 SORCERER 16K (Machine language)	$14.95

THE COUNT (by Scott Adams) - You wake up in a large brass bed in a castle somewhere in Transylvania. Who are you, what are you doing here, and WHY did the postman deliver a bottle of blood? You'll love this Adventure, in fact, you might say it's LOVE AT FIRST BITE.....

CS-3011 TRS-80 16K Level II (Machine language)	$14.95

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CIRCLE 205 ON READER SERVICE CARD

Grow, con't...

keywords or phrases that will cause certain actions:

```
EXTEND
KEY WORDS / PHRASES
: SPOCK
: KIRK
: MCCOY
: —
ACTIONS
: PHE'S AWAY ON A MISSION!
: —
EXTEND
KEY WORDS / PHRASES
: 1966
: —
ACTIONS
: PTHAT'S RIGHT — YOU've
 SAVED THE FLEET.
: +10
: GSICKBAY
: —
```

As the extensions given are entered immediately, the question "ASK KIRK" no longer fails; instead, a message is printed, as specified above.

```
ASK KIRK
HE'S AWAY ON A MISSION!
WHAT ABOUT SPOCK
HE'S AWAY ON A MISSION!
IT'S 1966
THAT'S RIGHT — YOU'VE
 SAVED THE FLEET.
DESCRIBE SICKBAY
```

One of the actions to be taken when "1966" is given is "GSICKBAY," that is, "go to the SICKBAY scene." GROW discovers that this scene has never before been entered, so the user is asked to describe it. The user then extends that scene.

```
: YOU ARE IN THE SICKBAY -
 AN ALIEN HAS A HEARTBEAT
 OF 57 BEATS
: PER HOUR. HOW MANY
 BEATS A YEAR IS THAT?
: (A STANDARD GALACTIC
 YEAR IS 365 EARTH DAYS)
: —
EXTEND
KEY WORDS / PHRASES
: 499320
: —
ACTIONS
: PTHAT'S IT
: +5
: GCASTLE2
: —
EXTEND
KEY WORDS / PHRASES
: MCCOY
: DOCTOR
: —
ACTIONS
:PTHE GOOD DOCTOR CAN'T
 HELP.
: —
```

Now the SICKBAY scene can be immediately used:

```
WHERE'S MCCOY
THE GOOD DOCTOR CAN'T
 HELP.
TELL MCCOY IT'S 499320
THAT'S IT
YOU ARE IN AN ANCIENT
 CASTLE TOWER, AND MUST
 TELL THE EVIL WIZARD THE
 FULL ORIGINAL NAME OF THE
 EMPEROR AUGUSTUS.
GAIUS OCTAVIUS
VERY GOOD.
```

And, finally:

```
HELP
TO QUIT, TYPE 'QUIT'
TO START OVER AGAIN, TYPE
 'RESTART'
TO ADD TO THIS* TYPE 'EX-
 TEND'
QUIT
QUIT WITH 70 POINTS
%
```

Using GROW

As the examples suggest, users of GROW always travel from scene to scene, or more precisely, from node to node. Correct answers typically cause a new node to be entered, but incorrect answers might also. The term "Node" is preferred over "scene" as sometimes a new node might still be refering to the same scene, as was the case in the cave example above.

Each node consists of an initial description of the node and a number of keywords/phrases matched with various actions. Whenever a user enters a new node, the description is printed (e.g., "YOU ARE IN A DARK EERIE CAVE"). However, if the node has never before been entered, then the user must instead provide an initial description for the node, which GROW records permanently (as in the SICKBAY node above). The keywords/phrases and actions can be added to a node via "EXTEND." In all cases, when node data is entered a blank line is used to indicate the end of the data. When the user is in a node, the actions will be performed if the command typed in by the user contains one of the associated keywords or phrases. Once one match is found, GROW will look no further. As an example, in the SICKBAY node the keyword "499320" has the actions "PTHAT'S IT," "+5," and "GCASTLE-2" associated with it while the keywords "MCCOY" and "DOCTOR" are associated with the action "PTHE GOOD DOCTOR CAN'T HELP." Due to the order in which these two extensions were made, the command "TELL MCCOY IT'S 499320" is interpreted correctly: GROW first tries to find "499320" and then, if that fails, it tries to find "MCCOY." Care is needed in cases like this, for if the node had been extended in the other order, "MCCOY" would be matched before "499320" and the user would not have been credited for the correct answer.

There are no limits on the number of nodes, extensions, keyword/phrases, or actions, or on the length of the initial descriptions of nodes other than the overall file space of CHAOS II. The set of primitive actions (those defined by GROW itself) is small but quite powerful. In addition to nodes, GROW also keeps track of the user's score and two of the primitive actions allow this to be modified. Two other primitive actions allow nodes to be entered and extended. The primitive actions are:

+number	- Adds points to the user's score, as in "+20."
-number	- Subtracts points from the user's score, as in "-15."
Ptext	- Prints out the text, as in "PTHAT MIGHT HARM IT."
Gnode	- Goes to another node, as in "GSICKBAY."
X	- Allows the user to extend the current node.
Q	- Causes GROW to print the user's score and quit.

These primitive actions are used much like statements in a programming language, and there is one restriction: actions following a "G," "X" or "Q" within the list of actions of a single extension are ignored. This is because GROW immediately goes to another node, modifies the current node, or quits, respectively, upon performing these actions and thus cannot come back to do the next.

When the user types in a command, GROW often searches the current node for a matching keyword or phrase unsuccessfully. If this happens, GROW will then search a node named DEFAULT. Some keywords in DEFAULT are "QUIT" and "EXTEND" which cause the "Q" and "X" actions, respectively. DEFAULT then becomes the current node and it can also be extended. If GROW cannot find a match in DEFAULT, then a random message is printed out and no action is taken. GROW also knows about a node named INIT, which is the current node whenever GROW is invoked from CHAOS II initially. INIT can also be extended in the normal fashion.

All of the effects illustrated in GROW can be obtained by clever uses of nodes, keyword/phrases and actions. For instance, GROW knows nothing of arithmetic but numerical

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Hardware options	40 column CRT 64 column CRT 80 col. terminal 80 col. printer included	64 col. CRT only 132 column printer only	80 col. CRT only 132 column printer only	cursor addressable terminal only 132 column printer only.
Is source code included?	YES, INCLUDING PROGRAM FLOWCHARTS.	YES	YES	NO
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CIRCLE 155 ON READER SERVICE CARD

Grow, con't...

answers can be stored as keywords. Placing spaces around numerical keywords can be used to insure correct matching. Experimentation is the best way to learn how to use GROW to set up lessons, tutorials, quizzes and games.

Inside GROW.

GROW is written in CHAOS II BASIC which is similar to most microcomputer versions. The program uses mainly strings (but no string arrays) and sequential files, and should be easy to transport onto most disk or cassette systems.

Nodes are stored in files with the name of the file being the name of the node. The internal format uses null strings to separate the components of the node. The format is:

1. The initial description of the node (zero or more strings),
2. A null string and
3. Zero or more of:
   a. a list of keywords/phrases (one to a line),
   b. a null string,
   c. a list of actions (one to a line) and
   d. a null string.

Nodes are extended by adding another list of keywords/phrases and list of actions at the end of the file (separated and terminated with null strings). Since files are totally dynamic in CHAOS II, GROW need not worry about the size of the node.

The main variables in GROW are:

- N$ the name of the node the user currently is in,
- P the user's score,
- I$ a line input from the user and
- S$ a line input from a file.

GROW is constructed modularly with the main program consisting of a call to the initialization subroutine and an infinite loop in which the subroutine to get and process commands from the user are called. The subroutines in GROW are:

INITIALIZE line 2000
Clears space for the strings and files, zeroes the score and causes the introductory message in the INIT node to be printed.

INPUT LINE line 3000
Gets a (command) line from the user. The prompt is a space.

PROCESS LINE line 4000
Tries to find a match for the (command) line by first looking in the current node (N$) and then in the DEFAULT node. The FIND LINE subroutine does the actual searching and returns with F set to 1 if, and only if, it has found a match. If a match is found, then the DO ACTIONS subroutine is used, otherwise a random response is given.

FIND LINE line 5000
Searches the currently opened file for a match to I$. Subroutine SKIP BLOCK is used to skip over the initial description of the node and later over the lists of actions. Subroutine GET LINE is used to obtain a line S$ which contains a keyword/phrase. FIND LINE returns with F = 0 unless a match is found - in which case F = 1.

DO ACTIONS line 5400
Finds and performs the actions associated with a keyword/phrase that has been matched. SKIP BLOCK is used to get to the list of actions and GET LINE is used to obtain the actions one at a time. Null and undecipherable actions are ignored. Subroutine CONVERT is used to get the numerical value for actions with "+" or "-." Subroutine GO TO NEW NODE is used for action "G;" subroutine EXTEND NODE is used for action "X."

RANDOM RESPONSE line 5800
Prints a random response.

SKIP BLOCK line 6000
Reads through a file (#1) until a null line or the end-of-file is encountered. For instance, SKIP BLOCK is used to advance through files containing nodes skipping over lists of actions.

GET LINE line 6200
Reads the next line from a file and returns this in S$. If there are no more lines, S$ is set to the null string.

CONVERT line 6400
Converts the second through the last characters of S$ into an integer and returns this in N.

INPUT NEW DATA line 6600
Obtains lines from the user and writes them into a node. The prompt is a colon. The user indicates the end of the list of lines by an empty line.

COPY NODE line 6800
Copies the current node into a node called TEMP. TEMP can later be expanded by subroutine INPUT NEW DATA.

GO TO NEW NODE line 7000
Sends a user to another node if the name appears legal. N$ is updated. If the node exists, subroutine GET LINE is used to help print out the description in the node. If the node does not exist, the ERROR trap is used and the user must describe the new node. The description is entered via subroutine INPUT NEW DATA. The ON ERROR GO TO 0 resets the ERROR trap.

EXTEND NODE line 8000
Uses INPUT NEW DATA to add the list of keywords/phrases and the corresponding list of actions to the current node. The COPY routine is required due to CHAOS II file usage.

```
BASIC
MITS BASIC Ver. 4.1
Ok
LOAD"GROW1
Ok
LIST

10 REM                  ***  EXTENSIBLE ADVENTURE  ***
20 REM                  *    COPYRIGHT (C) 1979     *
30 REM                  *      BY JEFF LEVINSKY     *
40 REM                  *    ALL RIGHTS RESERVED    *
50 REM                  * WRITTEN IN CHAOS II BASIC *
60 REM
1000 REM                                      MAIN LOOP
1010 GOSUB 2000
1020 GOSUB 3000
1030 GOSUB 4000
1040 GOTO 1020
2000 REM                                      INITIALIZE
2010 CLEAR 300,2
2020 P=0
2030 N$="INIT"
2040 I$=" INTRO "
2060 GOSUB 4000
2070 GOTO 1020
3000 REM                                      INPUT LINE
3010 LINE INPUT " ";I$
3020 I$=" "+I$+" "
3030 GOTO 1030
4000 REM                                      PROCESS LINE
4010 OPEN "I",1,N$
4020 GOSUB 5000
4040 IF F=1 THEN 4110
4045 CLOSE
4050 OPEN "I",1,"DEFAULT"
```

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```
4060 GOSUB 5000
4080 IF F=1 THEN 4110
4090 GOSUB 5800
4100 GOTO 4120
4110 GOSUB 5400
4120 CLOSE
4130 RETURN
5000 REM                                        FIND LINE
5010 F=0
5020 GOSUB 6000
5030 IF EOF(1) THEN RETURN
5040 GOSUB 6200
5050 IF S$=""THEN 5020
5060 S$=" "+S$+" "
5070 IF INSTR(I$,S$)=0 THEN 5020
5080 F=1
5090 RETURN
5400 REM                                        DO ACTIONS
5410 GOSUB 6000
5420 GOSUB 6200
5430 IF S$=""THEN RETURN
5440 T$=LEFT$(S$,1)
5450 IF T$="P"THEN PRINT MID$(S$,2):GOTO 5420
5460 IF T$="Q"THEN PRINT"QUIT WITH ";P;"POINTS":END
5470 IF T$="+" THEN GOSUB 6400:P=P+N:GOTO 5420
5480 IF T$="-"THEN GOSUB6400: P=P-N:GOTO5420
5490 IF T$="G"THEN GOSUB 7000:RETURN
5500 IF T$="X"THEN GOSUB 8000:RETURN
5510  GOTO5420
5800 REM                                         RANDOM RESPONSE
5810 R=INT(RND(0)*3)
5820 IF R=0 THEN PRINT"HUH?"ELSE IF R=1 THEN PRINT"WHAT"ELSE PRINT"I DON
'T UNDERSTAND"
5830 RETURN
6000 REM                                        SKIP BLOCK
6010 IF EOF(1)THEN S$="":RETURN
6020 INPUT#1,S$
6030 IFS$<>""THEN 6010
6040 RETURN
6200 REM                                        GET LINE
6210 IF EOF(1) THEN S$=""ELSE INPUT#1,S$
6220 RETURN
6400 REM                                        CONVERT
6410 N=0
6420 I=2
6430 IF I>LEN(S$)THEN RETURN
6440 N=N*10+ASC(MID$(S$,I,1))-ASC("0")
6450 I=I+1
6460 GOTO 6430
6600 REM                                        INPUT NEW DATA
6610 LINE INPUT ":";I$
6620 PRINT#1,I$
6630 IF I$<>""THEN 6610
6640 RETURN
6800 REM                                        COPY MODE
6810 OPEN "I",2,N$
6820 OPEN "O",1,"TEMP"
6830 IF EOF(2) THEN RETURN
6840 INPUT #2,I$
6850 PRINT #1,I$
6860 GOTO6830
7000 REM                                        GOTO NEW MODE
7010 IF(LEN(S$)<2)OR(LEN(S$)>9)THEN RETURN
7020 CLOSE
7030 N$=MID$(S$,2)
7040 ON ERROR GOTO 7100
7050 OPEN "I",1,N$
7060 GOSUB 6200
7070 IFS$=""THEN7150
7080 PRINTS$
7090 GOTO 7060
7100 RESUME 7110
7110 CLOSE
7120  OPEN "O",1,N$
7130 PRINT"DESCRIBE ";N$
7140 GOSUB 6600
7150 ON ERROR GOTO 0
7160 RETURN
8000 REM                                        EXTEND MODE
8010 CLOSE
8020 GOSUB 6800
8030 PRINT"KEY WORDS/PHRASES"
8040 GOSUB 6600
8050 PRINT"ACTIONS"
8060 GOSUB 6600
8068 CLOSE
8069 KILLN$
8070 NAME "TEMP"AS N$
8080 RETURN
```

Figure 1

To run GROW on a new system, the nodes INIT and DEFAULT must also be provided. On CHAOS II, these nodes can be created using the text editor. On other systems a short program can be written to read lines from the terminal and place them in a file of strings. The listings of GROW, INIT and DEFAULT are given in Figure 1.

Beyond GROW

Some of the features absent in GROW are actually provided by the CHAOS II system. These include the ability to have several GROW subsystems and the ability to protect specific nodes from extension. CHAOS II also enforces a quota on files thus preventing GROW from overgrowing the entire computer. Users of other systems might obtain these features by modifying GROW itself. For instance, GROW might automatically prefix each node name with an ASCII character indicating to which subsystem the node belongs. This provides up to 256 subsystems and prevents errors arising from similarly-named nodes in different subsystems.

Those accustomed to programming languages such as BASIC or PILOT will probably feel uncomfortable with the limited number of primitive actions that GROW provides. A language such as BASIC or PILOT could be used in place of the primitive actions, but the implementation can be difficult. One technique is to encode nodes as subroutines rather than as data files and to merge the current node into the program workspace. Certain BASICs appear to have this capability.1 Another technique, which can be used with BASICs that provide an immediate mode, is to encode GROW in assembly language and have it call upon the BASIC to execute the actions in the node. Using a high level language for actions does require that all users who add extensions learn that language (or at least a subset of it), which may be impractical, especially with elementary school students.

7 POINT FOOTNOTE GOES HERE

On larger computers, GROW can very easily be implemented in interactive languages such as APL and LISP.

In connection with a computer science curriculum, GROW can be used effectively as a base for a series of programming exercises. For example, a program can be written which will find all nodes and all paths between nodes. This can then be modified to print all of the descriptions of nodes or all of the keywords and phrases. If the GROW program has been in use for some time, the

Grow, con't...

listings of what has been added can be quite amusing. An advanced project is to find the shortest way (in terms of nodes visited) to score as many points as possible (without scoring at a particular node more than once). This is a variant of the Traveling Salesman problem.

Finally, imagine a single GROW system on a network of personal computers, with thousands of users playing simultaneously. Even with only a dozen or so users providing extensions at a time, one could be certain to be able to explore new nodes forever. □

References

1. Kroening, Mary E. **CHAOS User's Manual.** San Diego, California: 1978.

2. Levinsky, Jeff L. "CHAOS: An Interactive Timeshared Operating System for the 8080," **Dr. Dobb's Journal.** XXXI (January, 1979), 6-13.

CHAOS II

CHAOS II is a multi-user, multi-tasking 8080-based system developed at Clairemont High School in San Diego, California as an economical alternative to large timeshare or networked microprocessor installations. CHAOS II permits at least half a dozen students to simultaneously develop and/or run programs written in BASIC, 8080 machine language and SHELL (a powerful command language). Students and teachers may each have private directories; both files and directories may have access rights specified to restrict or allow access from other directories. CHAOS II currently uses floppy disks for mass storage, and directories are assigned to a particular disk, thereby permitting one disk to be used per class. This in turn results in greater economies, as the disks for one class can be copied and dismounted and the disk for another class mounted on the same drive within a five to ten minute class break.

For further information about CHAOS II, please write to:

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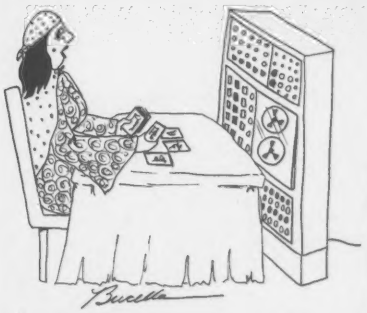

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Recursive Procedures In Fortran

Brian Hess

How often have you seen some fancy algorithms written up in a book or magazine using a corrupted ALGOL-like notation which took advantage of recursion? Ever had to just skip right past it because, while you understood recursion, you had no language available to you on your micro, mini, or school computer which supported recursive procedures? No longer — you can use FORTRAN! As klugy and primitive a language as it may be, through the miracle of the "ASSIGN" and assigned "GO TO" statements, recursion can be very easily simulated.

Brian Hess, 362 Memorial Dr., Cambridge, MA 02139.

Program A

```
      INTEGER STACK,TOP,RTNADR
      COMMON TOP,STACK(256)
        .
        .
        .
C *** CALL TO THE RECURSIVE PROCEDURE AT
                                    STATEMENT 200 ***
      ASSIGN 100 TO RTNADR
      CALL PUSH(RTNADR)
      GO TO 200
  100 CONTINUE
        .  <more of main program>
        .
        .
      CALL EXIT
C *** STATEMENT 200 BEGINS A RECURSIVE PROCEDURE ***
  200   .  <procedure body>
        .
        .
      CALL POP(RTNADR)
      GO TO RTNADR
C *** END OF PROCEDURE ***
      END

      SUBROUTINE PUSH(ITEM)
      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** PUT SOMETHING ON THE TOP OF OUR STACK ***
      TOP = TOP+1
      IF (TOP.GT.256) CALL STRACE
      STACK(TOP) = ITEM
      RETURN
      END

      SUBROUTINE POP(ITEM)
      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** GET THE TOPMOST THING OFF THE STACK ***
      IF (TOP.EQ.0) CALL STRACE

      ITEM = STACK(TOP)
      TOP = TOP-1
      RETURN
      END

      SUBROUTINE STRACE
C *** WE MUST HAVE PUSHED OR POPPED TOO FAR -
                              EXECUTE STACK TRACE ***
      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** REPORT WHICH IT WAS ***
      WRITE(6,1) TOP
    1 FORMAT(1H1,//,'THE PUSHDOWN STACK BOUNDS HAVE
                                        BEEN EXCEEDED'
     1,/,' ***** TOP OF STACK NOW = ',I10,/)
      WRITE(6,2) STACK
    2 FORMAT(//,' ***** STACK CONTENTS *****'
                                       ,/,(10I10,/))
      STOP 'ERROR'
      END
```

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Recursive, con't...

A Quick Review of Recursion

A function is recursive when it calls itself. (It can also call a second function which calls the first, etc.) Let's use the factorial function to illustrate. (A factorial is the product of the integers between 1 and a given integer. For example, 5 factorial, written 5!, is 5x4x3x2x1 = 120.) We will use the property that N! = Nx(N-1)!. (5! = 5x4!) If FORTRAN allowed procedures to call themselves, our factorial function might look like this:

```
      FUNCTION IFACT(N)
C *** 0! IS DEFINED TO BE EQUAL TO 1 ***
      IF (N.NE.0) GO TO 10
      IFACT = 1
      RETURN
C *** ELSE RECURSE ***
   10 IFACT = N*IFACT(N-1)
      RETURN
      END
```

If you want a more complete explanation of recursion or stacks and some relation to BASIC, refer to the article "Something is Missing" by Craig Finseth in **Creative Computing**, November/December 1977.

How to do it in Legal FORTRAN

To implement a recursion scheme, you save return addresses on a pushdown stack. Program A demonstrates the technique.

The "ASSIGN" statement and the unconditional "GO TO" in Program A behave like the machine instructions which the compiler generates for an ordinary subroutine call, i.e., they save the return address and transfer control to the subroutine. The difference is that the return address is saved on a pushdown stack by "CALL PUSH(RTNADR)" instead of a fixed location. This makes recursion possible. Note that all of the recursive procedures must belong to the same FORTRAN compilation, since "RTNADR" must be recognized and treated as a local address by the FORTRAN compiler.

An Example

Let's look at an example. Program B calculates factorials; it again uses the definition N! = Nx(N-1)!. This is not the fastest way to compute factorials, but it's a very easy test run to program. There is a slight difference between Program B and Program A. Program B must call the routine with an argument (the number to be "factorialized"), so an extra call to "PUSH" is done every time the routine is called.

Don't forget that when pushing or popping arguments on the stack, the recursive procedure must obey a "stack discipline." All this means is that whatever items any routine pushes onto the stack it must pop off again before returning from the call. In the example, when setting up for the recursive call, we push two items: the return address and the value of the argument previously passed minus one. When entering the factorial routine, we pop one item (the argument) off, and when the "return" is executed at statement 155, the other item is popped.

```
1           INTEGER STACK,TOP,RTNADR
2           COMMON TOP,STACK(256)
3     C *** 'GLOBAL' WILL HOLD OUR RESULT ***
4     C *** 'ARG' IS USED TO GET OUR ARGUMENT OFF
                                        THE STACK ***
5           INTEGER GLOBAL,ARG
6     C *** COMPUTE 10 FACTORIAL ***
7           N = 10
8     C *** PUSH ON RETURN ADDRESS, THEN ARGUMENT TO
                                        BE PASSED ***
9           ASSIGN 50 TO RTNADR
10          CALL PUSH(RTNADR)
11          CALL PUSH(N)
12          GO TO 100
13       50 WRITE(6,51) GLOBAL
14       51 FORMAT(' 10! = ',I10)
15          CALL EXIT
16    C
17    C
18    C
19    C *** RECURSIVE PROCEDURE FACTORIAL ***
20    C
21    C *** CHECK IF ARGUMENT = 0 -- 0! DEFINED
                                        AS 1 ***
22       100 CALL POP(ARG)
23           IF (ARG.NE.0) GO TO 110
24           GLOBAL = 1
25           GO TO 155
26    C *** REPLACE ARGUMENT ***
27       110 CALL PUSH(ARG)
28    C *** CALL FACTORIAL(ARG-1) ***
29           ASSIGN 150 TO RTNADR
30           CALL PUSH(RTNADR)
31           CALL PUSH(ARG-1)
32           GO TO 100
33    C *** WE FINALLY GOT AN 'ASSIGNED GO' TO 150
                              - START MULTIPLYING **
34       150 CALL POP(ARG)
35           GLOBAL = GLOBAL*ARG
36    C *** RETURN ***
37       155 CALL POP(RTNADR)
38           GO TO RTNADR
39           END
```

Program B

But look at statement 110. Isn't it kind of unusual that we took the argument off the stack and then pushed it right back on again? Does this violate our stack discipline? No, we just didn't want "ARG" to get trampled by the next recursive call to our factorial procedure. "ARG" was used as a "local variable" which most other languages would save for us during recursion, but which we must save for ourselves in FORTRAN. It is popped off later when multiplying "GLOBAL" at statement 150, keeping the stack level correct.

Extra Fun

So, to create recursive procedures in FORTRAN (or assembly language, for that matter), we must use a pushdown stack to hold return addresses and (sometimes) simple arguments and local variables. What needs to be done in our example to pass real numbers as arguments? Variable-length character strings? Does this add any new restriction to our stack discipline? Can you think of a way to modify "PUSH" and "POP" so that "STRACE" can tell what kind of a variable or address is contained in "STACK" and print each element in the stack dump using the proper format? Try the simple recursion example for a start. Good luck!

Acknowledgement

Many thanks to Walter Gilbert at the University of Maryland for publishing a list of UNIVAC 1100 programming tricks from which this ideas was borrowed.

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```
      INTEGER STACK,TOP,RTNADR
      COMMON TOP,STACK(256)
C *** 'GLOBAL' WILL HOLD OUR RESULT ***
C *** 'ARG' IS USED TO GET OUR ARGUMENT OFF
                                    THE STACK ***
      INTEGER GLOBAL,ARG
C *** COMPUTE 10 FACTORIAL ***
      N = 10
C *** PUSH ON RETURN ADDRESS, THEN ARGUMENT TO
                                        BE PASSED ***

      ASSIGN 50 TO RTNADR
      CALL PUSH(RTNADR)
      CALL PUSH(N)
      GO TO 100
   50 WRITE(6,51) GLOBAL
   51 FORMAT(' 10! = ',I10)
      CALL EXIT
C
C
C
C *** RECURSIVE PROCEDURE FACTORIAL ***
C
C *** CHECK IF ARGUMENT = 0 -- 0! DEFINED AS 1 ***
  100 CALL POP(ARG)
      IF (ARG.NE.0) GO TO 110

      GLOBAL = 1
      GO TO 155
C *** REPLACE ARGUMENT ***
  110 CALL PUSH(ARG)
C *** CALL FACTORIAL(ARG-1) ***
      ASSIGN 150 TO RTNADR
      CALL PUSH(RTNADR)
      CALL PUSH(ARG-1)
      GO TO 100
C *** WE FINALLY GOT AN  ASSIGNED GO' TO 150 -
                                    START MULTIPLYING ***
  150 CALL POP(ARG)
      GLOBAL = GLOBAL*ARG
C *** RETURN ***
  155 CALL POP(RTNADR)
      GO TO RTNADR
      END

      SUBROUTINE PUSH(ITEM)
      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** PUT SOMETHING ON THE TOP OF OUR STACK ***
      TOP = TOP+1
      IF (TOP.GT.256) CALL STRACE
      STACK(TOP) = ITEM
      RETURN
      END
      SUBROUTINE POP(ITEM)
      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** GET THE TOPMOST THING OFF THE STACK ***
      IF (TOP.EQ.0) CALL STRACE
      ITEM = STACK(TOP)
      TOP = TOP-1
      RETURN
      END


SUBROUTINE STRACE
C *** WE MUST HAVE PUSHED OR POPPED TOO FAR
                          - EXECUTE STACK TRACE ***

      INTEGER STACK,TOP
      COMMON TOP,STACK(256)
C *** REPORT WHICH IT WAS ***
      WRITE(6,1) TOP
    1 FORMAT(1H1,//,'THE PUSHDOWN STACK BOUNDS
                                    HAVE BEEN EXCEEDED
     1,/,' ***** TOP OF STACK NOW = ',I10,/)
      WRITE(6,2) STACK
    2 FORMAT(//,' ***** STACK CONTENTS *****
                                        ',/,(10I10,/))
      STOP 'ERROR'
      END
```

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CIRCLE 139 ON READER SERVICE CARD

Now your Apple can tick, chime, and keep time.

Grandapple Clock

Christopher Howerton

The enclosed program was written by William B. Smith of Gambier Island, British Columbia. Here is his description.

This program is an attempt to humanize the computer a little by having it perform the old-fashioned functions of a grandfather clock. Using the Grandapple clock has certain advantages over a regular clock:

1) it will keep the Apple II working 24 hours a day rather than gathering dust in a corner, or (if switched on) maybe figuring out how to program itself.
2) allows for operation of a a grandfather clock regardless of gravity -- a useful feature when visiting the moon
3) costs less than a real grandfather clock (not counting the computer, of course)

Other uses of the Grandapple clock include store display, timing games, and showing modern day children what clocks used to look like in the analog era.

The program displays, graphically, a clock face on the monitor, using the high resolution graphics facilities of the Apple. It uses Roman numerals to mark the hours, has a long and a short hand, and has gothic style columns on either side of the clock face just to balance the display.

The menu at the start of the program allows the user to have sound effects (chimes, ticks and tocks with a visual pendulum and an alarm.)

To Use

a) This program requires 24K bytes of RAM.
b) Load Applesoft Basic (cassette version)
c) Load the program in the usual manner, and type 'RUN'
d) Now follow the instructions in the menu.
e) To stop the clock, hit any key
f) To turn off the alarm, hit any key.

Note that the program simulates the clock without use of any special hardware. This is done by using timing loops. This program uses the simple tone routine by P. Lutas which is in the red Apple Manual.

Line by line description:

Lines 0-99 were originally reserved for REMs, but Murphy's Law regarding program size expanding to fit available memory applied!

100-149 are the basic timekeeping loop. The variable E allows for the different subroutine options (e.g. chimes) to have the amount of time they use deducted from the variable which keeps the clock accurate. Line 120 branches the program to the "tick tock" routine, which has its own timing loop. Line 130 allows the user to exit the program by depressing any key.

150-199 keep the minutes, hours and am/pm flags updated. Line 160 also branches to the "alarm" routine, if the alarm is set, to check whether it is time to ring the alarm. This occurs once each minute.

200-299 draw and erase the minute and hour hands. The several IF statements control the display of the hands when they pass each other
pm% new position of minute hand
ph% new position of hour hand
opm% old position of minute hand
xph% old position of hour hand
Line 285 branches program to "chimes" routine once per hour if the flag is set

300-349 control the "tick tock" and pendulum features. If this option is being used, lines 305-315 control the timekeeping loop. Lines 325&335 call for the tick and the tock noise. Lines 330&340 draw, and lines 347 & 348 erase the pendulum. The variable B keeps track of whether the clock ticked or tocked last time.

350-399 are the chimes option. Lines 350-363 call for a little tune. Lines 365-385 chime the number of hours. Line 390 keeps account of the time used for the above.

400-499 are the alarm option. Lines 400-415 are checked once each minute, if the alarm is set, to see if it is time to start ringing. The remaining lines produce an interrupted tone until any key is depressed.

500-599 provide the data for the short tune, the various shapes, and the position of these shapes on the hgr2 display page.

600-699 are mostly read statements to draw the clock face. Line 690 makes a machine code program for sounds (written by P. Lutas).

700-799 include the menu and and input statements.

800-849 are the exit from the program after any key is depressed.

Christopher Howerton, 13572 92 Avenue, Surrey, B.C. Canada V3V 1H7.

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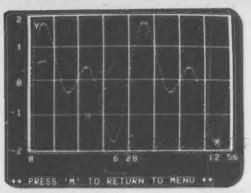

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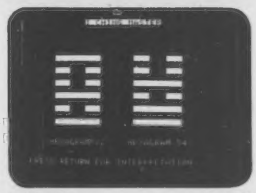

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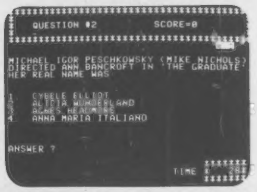

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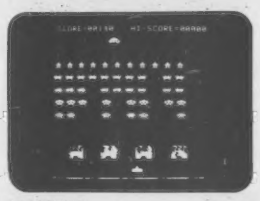

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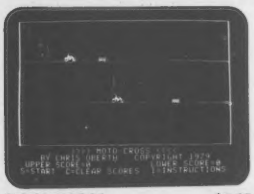

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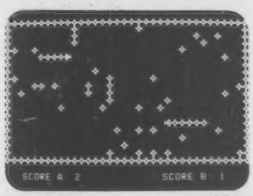

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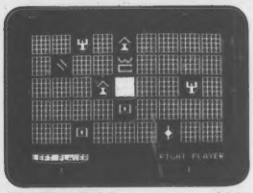

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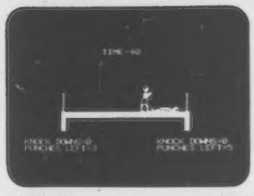

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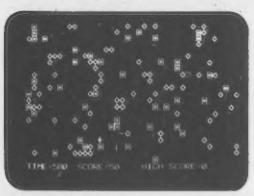

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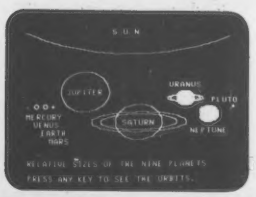

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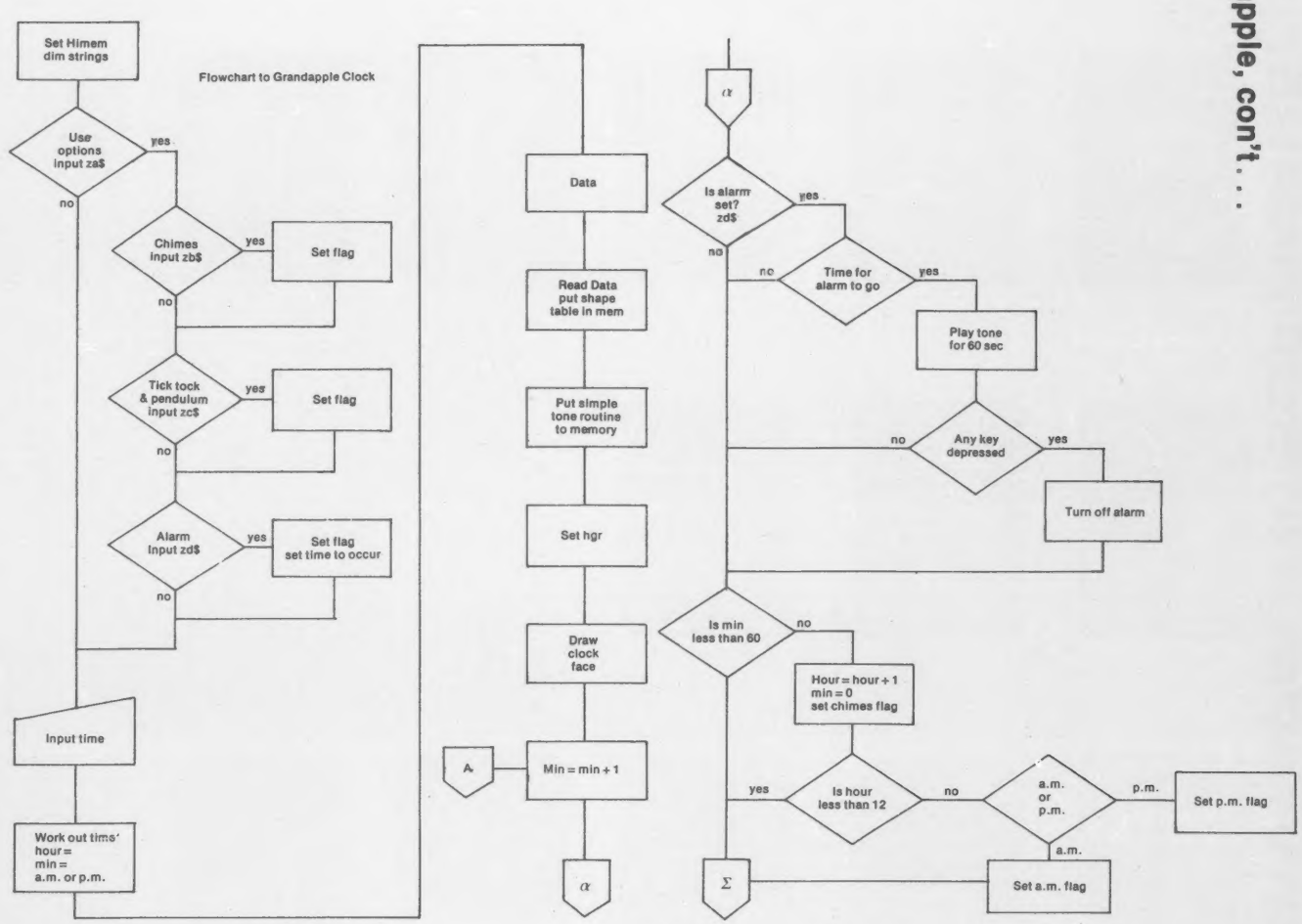
CIRCLE 148 ON READER SERVICE CARD

```
>PR#0##############

]LIST GRANDAPPLE CLOCK

3  HIMEM: 16277
4  DIM ZD$(1),ZC$(1),ZB$(1),ZA$(1
   )
5  GOTO 700
90 E = 420 + (H * 140)
119 E = 1
120  IF  ASC (ZC$) = 89 THEN  GOTO
   300
125  FOR A = E TO 4862
130  IF  PEEK ( - 16384) > 127 THEN
    GOTO 800
140  NEXT A
160 MIN = MIN + 1: IF  ASC (ZD$) =
    89 THEN  GOSUB 400
165  IF MIN < 60 THEN  GOTO 200
170 MIN = 0:HOUR = HOUR + 1
172  IF  ASC (ZB$) = 89 THEN FLAG
    = 1
175  IF HOUR < 12 GOTO 200
180 HOUR = 0: IF PM = 1 THEN PM =
    0: GOTO 200
185  IF PM = 0 THEN PM = 1: GOTO
    200
200  SCALE= 12
205 PM% = MIN * 64 / 60: ROT= PM%
    : GOSUB 290
210 PH% = (HOUR * 64 + PM%) / 12:
     ROT= PH%: GOSUB 295
215  IF PH% = XPH% THEN  ROT= PH%
    : GOSUB 295
220  IF PM% = PH% THEN  ROT= PH%:
     GOSUB 295
225  IF B = 0 THEN  GOTO 285
230  ROT= OPM%: GOSUB 290
235  ROT= XPH%: GOSUB 295
240  IF OPM% = PH% THEN  ROT= PH%
    : GOSUB 295
241  IF HOUR = 6 AND MIN = 34 THEN
     ROT= PH%: GOSUB 295
245  IF XPH% = PM% AND XPH% <  >
    PH% THEN  ROT= PM%: GOSUB 29
    5
246  IF PM% = XPH% AND PH% = PM% +
    1 THEN  ROT= PM%: GOSUB 295
250  IF PH% = XPH% THEN  ROT= XPH
    %: GOSUB 295
285 OPM% = PM%:XPH% = PH%:B = 1:E
    = 1:  IF FLAG = 1 THEN  GOSUB
    350
286 FLAG = 0:  IF R = 0 THEN  GOTO
    120
287  GOTO 160
290  XDRAW 1 AT 140,80:  RETURN
295  XDRAW 2 AT 140,80:  RETURN
300  ROT= 7:  DRAW 7 AT 80,180:G =
    19
305  FOR A = E TO 4862 STEP 67:Q =
    1
```

Flowchart to Grandapple Clock



Grandapple, con't . . .

```
307  FOR F = G TO 60
310  IF  PEEK ( - 16384) > 127 THEN
      GOTO 800
315  NEXT F
320  IF B = 1 GOTO 335
325  POKE 768,100: POKE 769,03: CALL
     770
330  DRAW 7 AT 80,180:B = 1: XDRAW
     7 AT 168,180: GOTO 345
335  POKE 768,70: POKE 769,03: CALL
     770
340  DRAW 7 AT 168,180: XDRAW 7 AT
     80,180:B = 2
345 G = 1: NEXT A
347  IF B = 1 THEN  XDRAW 7 AT 80
     ,180
348  IF B = 2 THEN  XDRAW 7 AT 16
     8,180
349 E = 1: GOTO 160
350  RESTORE
355  FOR A = 0 TO 3: READ E
360  POKE 768,E: POKE 769,50: CALL
     770: FOR F = 1 TO 200: NEXT
     F: NEXT A
361  IF A = 8 GOTO 365
362  FOR F = 1 TO 400: NEXT F
363  FOR A = 4 TO 7: READ E: GOTO
     360
365  FOR A = 1 TO 1000: NEXT A
370 H = HOUR: IF HOUR = 0 THEN H =
     12
375  FOR E = 1 TO H: POKE 768,250
     : POKE 769,100: CALL 770
380  FOR F = 1 TO 800: NEXT F
385  NEXT E
390 E = 500 + (H * 133)
395  RETURN
400  IF MIN = 60 THEN ALARM = (HO
     UR + 1) * 100: GOTO 405
403 ALARM = HOUR * 100 + MIN
405  IF PM = 1 THEN ALARM = ALARM
      + 1200
410  IF ALARM = SET GOTO 420
415 E = 4: RETURN
420 SET = SET + 1:E = 1:R = 1

435  FOR A = E TO 87
440  IF  PEEK ( - 16384) > 127 THEN
     ZD$ = "N":R = 0: GOTO 455
445  POKE 768,255: POKE 769,255: CALL
     770
450  NEXT A
455  POKE  - 16368,0
465  RETURN
500  DATA  100,150,100,250,100,15
     0,50,150
505  DATA  08,00,18,00,22,00,25,0
     0,32,00,44,00,70,00,73,00,77
     ,00

510  DATA  36,36,36,00
515  DATA  36,36,00
520  DATA  54,54,54,54,54,14,00
525  DATA    118,118,118,118,118,
     05,100,100,100,100,100,12,0

530  DATA  14,14,14,14,14,14,14,1
     4,14,14,222,219,219,27,96,12
     ,12,12,12,12,12,12,12,12,12,
     00
535  DATA  53,39,00
540  DATA  44,62,00
545  DATA  63,63,54,45,53,62,62,
     62,54,53,53,62,62,46,46,54,5
     5,55,46,46,46,54,63,55,46,45
     ,5,0
550  DATA     144,1,148,1,178,14,
     200,40,204,40,208,74,212,74,
     216,74,216,74,200,110,146,14
     8,98,136,102,136,74,110,78,1
     10,82,110,60,73,100,13
555  DATA  204,110,178,136,132,14
     8,84,136,60,110,64,74,70,40,
     86,14,138,2,138,16,170,24,19
     2,46,200,78,192,110,170,132,
     138,140,106,132,84,110,76,78
     ,84,46,106,24
580  DATA  173,48,192,136,208,5,2
     06,1,3,240,9,202,208,245,174
     ,0,3,76,2,3,96
600  FOR A = 1 TO 8: READ B: NEXT
     A
605  FOR A = 16278 TO 16382: READ
     B: POKE A,B: NEXT A
610  HGR2 : HCOLOR= 3: SCALE= 1: ROT=
     0
620  POKE 232,150: POKE 233,63
630  HIMEM: 16277
640  FOR A = 1 TO 10: READ B,C: DRAW
     3 AT B,C: NEXT A
650  FOR A = 1 TO 5: READ B,C: DRAW
     4 AT B,C: NEXT A
660  FOR A = 1 TO 4: READ B,C: DRAW
     5 AT B,C: NEXT A
670  FOR A = 1 TO 12: READ B,C: DRAW
     6 AT B,C: NEXT A
680  SCALE= 5: DRAW 8 AT 25,16: DRAW
     8 AT 252,16: ROT= 32: DRAW 8
      AT 26,141: DRAW 8 AT 253,14
     1
690  FOR A = 770 TO 790: READ B: POKE
     A,B: NEXT A
695 A = 0:B = 0:C = 0:XPH% = 65:X
     PM% = 65: GOTO 160
700  CALL  - 936
701  PRINT "(THIS PROGRAM WRITTEN
      BY BILL SMITH,      GAMBIER
     ISLAND, B.C. CANADA)": PRINT
     : PRINT

705  PRINT "HI,I'M APPLES GRANDFA
     THER CLOCK": PRINT  SPC( 40)

706  PRINT "DO YOU WANT ME TO CHI
     ME THE HOURS OR USEMY OTHER
     FACILITIES ?": PRINT " "
707  INPUT "PLEASE TYPE Y OR N,TH
     EN HIT 'RETURN'KEY";ZA$
710  IF  ASC (ZA$) <  > 89 THEN  GOTO
     765
714  CALL  - 936
715  PRINT "WHICH OF THE FOLLOWIN
     G WOULD YOU LIKE?,"
716  PRINT "JUST PRINT Y OR N,
                          (DON'T
     FORGET TO HIT THE RETURN KEY
     )"
717  PRINT "      "
718  PRINT " "
720  INPUT "CHIMES?";ZB$
725  INPUT "TICK TOCK?";ZC$
730  INPUT "ALARM?";ZD$
732  IF  ASC (ZD$) <  > 89 THEN  GOTO
     770
735  PRINT " ": INPUT "WHAT TIME
     DO YOU WANT THE ALARM TO GO
       OFF?

                                PL
     EASE USE 24 HOUR NOTATION,FO
     R EXAMPLE 1340 AND NOT TWENT
     Y TO TWO";SET
736  GOTO 770
765 ZB$ = "N":ZC$ = "N":ZD$ = "N"

770  CALL  - 936
771  INPUT "WHAT IS THE PRESENT T
     IME PLEASE? USE 24 HOUR NOTA
     TION, FOR EXAMPLE 1340 AND N
     OT TWENTY TO TWO";A
772  CALL  - 936: PRINT "HANG ON
     WHILST I WIND THIS APPLE UP"

773 A = A - 1
774  FOR Q = 1 TO 999: NEXT Q
775 MIN = ( INT ((A / 100 -  INT
     (A / 100)) * 100 + .05) *  SGN
     (A / 100))
780  IF A > 1200 THEN A = A - 120
     0:PM = 1
785 HOUR = (A - MIN) / 100:A = 0
790  IF HOUR = 12 THEN HOUR = 0
795  GOTO 500
800  TEXT : CALL  - 936
810  PRINT "STOP PLAYING WITH THE
      APPLE !!!!, GO AND TELL DAD
      TO WIND UP THE CLOCK AND ST
     ART IT AGAIN"
```

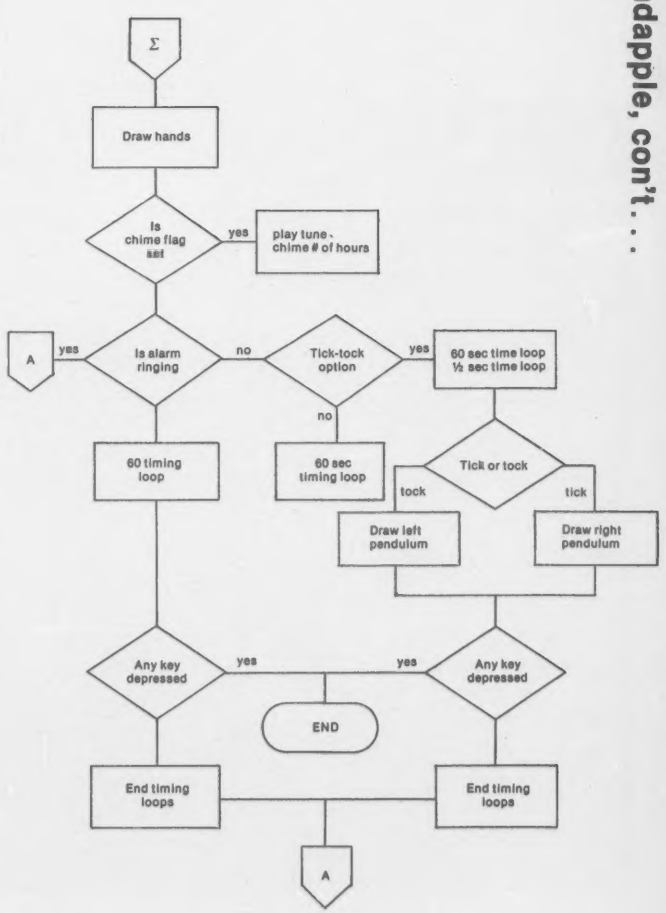


Photo Courtesy of Federal Aviation Administration

Air Traffic Controller

David Mannering

Sam, a friend of mine, called me the other day. He sounded exhausted, his voice weak and raspy. "Dave," he said, "you've got to destroy that game. Burn the cassettes. It's a menace."

I had no pity. Sam had just won a "twenty" game of ATC, the air traffic control simulation game, on his TRS-80. This should have been a cause for elation, since winning at that level is extremely difficult. However, Sam's win came at the end of a series of three and four hour sessions that were interrupted only for work and, less frequently, food and sleep. He complained that ATC was taking up his whole life and vowed never to play it again. But I've heard that before.

ATC is a game in which you are an air traffic controller with the responsibility for the safe and expeditious flow of air traffic within a 15 x 25 mile area from ground level to 5,000 feet in altitude. Within your area are two airports, two navigational beacons (navaids), and ten entry/exit fixes. During your shift as controller in charge of this airspace, 26 aircraft will become active and under your control. Some of them will be jets travelling 4 miles per minute, and some will be props travelling only half that fast. Some will depart from an airport and fly out an exit fix, some will enter via an entry fix and land at an airport, and some will simply fly from one fix to another. They will come at various times, headings and altitudes, whether you are ready for them or not.

Your goal is to get all of the aircraft to their assigned destinations before your shift is completed. At your disposal are the computer-assisted radar display of the aircraft's positions in the control area; coded information concerning aircraft heading, destination and fuel supply; navaids enabling you to hold aircraft or assign them automatic approaches; and commands to alter the altitude or heading of an aircraft. Working against you are altitude and heading requirements for landing or exiting aircraft, fuel restrictions and, of course, the clock. The biggest problem you will encounter, however, is the game's fundamental aircraft separation rule: No two aircraft can be less than three miles from each other at the same altitude.

Before the game is discussed in more depth it might be useful to say a few things about what ATC is a simulation of, namely, air traffic control via computer assisted radar.

When you think of a radar scope, you may think of a large round screen with a luminous arm sweeping around it like the second hand of a watch and filled with little dots which represent aircraft. However, in air traffic control there is a lot more. The screen has a map showing airports, radio towers and other useful things superimposed on it. Also, it has mile markers to aid the controller in judging the distance between two aircraft. In addition, many of the little dots have alphanumeric tails which follow them across the screen. These tails contain coded information about

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ATC, con't . . .

the aircraft, including call-sign, type, altitude and ground speed. These tails are generated by a computer and are but the most visible aspect of a nation-wide network of air traffic tracking systems. Each radar scope has a keyboard associated with it, and the controller communicates to the computer through it even as he communicates to the aircraft pilot through his microphone.

For training purposes, it is possible for the computer to generate imaginary aircraft which the controller can maneuver through the keyboard. The program which enables this is called a "target generator" and it is the inspiration for ATC.

ATC is written in machine language and executes in real time. It retains the basic realism of radar air traffic control, but adds the excitement and well-defined goals of a game. Perhaps the best way to describe ATC in detail is to look at how the game begins, and how it ends.

To begin, execute the program and the radar screen, complete with map and mile markers appears. Make sure you're familiar with the map, the locations of the airports, navaids and fixes, as well as the appropriate headings for each. Then enter a clock setting for the number of minutes you want the game to last and the game has started. Perhaps nothing happens for a minute or two, but then some coded information appears in the preview area at the right side of the screen. It tells you of an inbound jet from fix 7, coming in at 6,000 feet, heading northwest, bound for the main airport. It won't be in your area for another minute, so merely note it and move on to the other information in the preview area. It says that a prop is waiting to depart from the secondary airport. Its destination is fix 5. Clear it for takeoff with a final altitude of 5,000 feet and instruct it to turn left 135 degrees after departure. The pilot responds "ROGER," and in 30 seconds the aircraft is airborne and visible on your radar. Now the inbound has appeared and preview area shows three more aircraft will be inbound in the next minute. Clear the first one for an approach to the main airport and begin figuring how you are going to divert two of the inbounds around your departure. You settle in for a busy shift.

There are six ways in which a game of ATC can end, and each has its own story.

Boundary error: The airspace which you control is surrounded by other airspace which is presided over by other controllers. Just as there are definite ways in which aircraft enter your airspace from these other areas, so there are definite ways in which aircraft must exit your airspace to enter these other areas. The controller next door doesn't want any surprises. Thus, the aircraft must leave via the proper exit fix at the proper altitude and heading. Failure to meet these requirements ends the game with a boundary error. Perhaps the most common cause of this is forgetting to turn an aircraft in time, so that it arcs out of your control area before completing a turn.

Conflict: This is by far the most common ending for a game. Aircraft travel very fast and have a large turning radius. Also, radar is not always a very precise representation of where an aircraft really is. Therefore, it is necessary to keep aircraft separated by a comfortable distance to provide a margin of safety as they whiz past one another. The basic rule of radar control is separation of either three miles or one thousand feet. The one thousand feet refers to altitude and is so slight because altimeters are more accurate than radar and because aircraft do not normally change altitude as fast as they change lateral position. The three miles applies whether the aircraft are converging, diverging, or flying parallel courses. There is a lot of space in your control area. Unfortunately, aircraft do not tend to distribute themselves uniformly throughout it, but bunch up around the airports and navaids. Free altitudes in these areas can get scarce quickly, and a familiar sight in the middle of the swarm is the conflict mark which shows where the three mile rule was broken and ends the game. Bad habits, such as flying aircraft near fixes at high altitudes, or near airports at low ones, can contribute to the frequency of this ending.

Fuel exhaustion: Fuel is not normally a factor in air traffic control. Aircraft are supplied with plenty of fuel to get to their destination with a normal amount of handling. However, excessive delay, whether it be in a holding pattern or sitting on the taxiway waiting for a takeoff clearance, can bring a certain sense of urgency to the aircraft's fuel situation. Fuel in aircraft is measured in minutes remaining rather than gallons. More than one game has been lost when the player realized that aircraft whose destination is three and one-half minutes away has only three minutes of fuel remaining. This can happen if you are the kind of player who likes to save the departures for the end of the game.

Time Limit: The main measure of difficulty of a game is the clock setting at the beginning. You will control the same number of aircrft in a 16 minute game as you will in a 99 minute game. The only difference is that in a 99 minute game you will have time to go fix a sandwich between the appearance of two successive aircraft, while in the 16 minute game you may not even have time to swallow before all of the aircraft have appeared. The last 15 minutes of a game is a free period in which no new aircraft will appear. This is to give you time to sort out your existing problems before the game ends. In theory this makes it possible to win every game, since even a prop traversing your airspace lengthwise requires only twelve and one-half minutes to do so, providing you do not divert it. However, as with fuel, excessive delays can cause time to become a critical factor. Even without delays some games are very time sensitive, and it can be easily demonstrated that not all games can be won before the clock reaches

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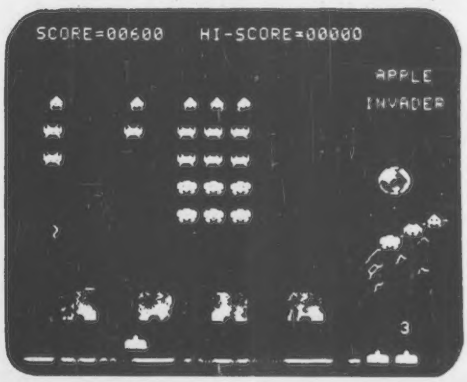

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CIRCLE 205 ON READER SERVICE CARD

ATC, con't . . .

zero. The incidence of such games is, fortunately, rare.

Terminated: This ending occurs because you have seen the inevitability of one of the above endings, or you smell smoke and hear sirens stopping out front. This, like resigning in chess, is a dignified way to admit that you blew it.

Success: Well-deserved and heady. Keeping in mind that in real air traffic control mistakes can be fatal and it is probably better to win a game at level 60 than lose with only one aircraft remaining at level 20. However, for a measure of pure skill, even losing at the lower levels may require better playing than winning at a higher level. Within each level, the fewer aircraft remaining at games end the better, and in case of a tie, the one with the most time left on the clock might be taken as the better player, though in some cases this is not a very good indicator.

This might be taken as a general rating of game levels, though it is possible to have both very easy and very difficult games at almost any level.

LEVEL RATING

80-99 Beginners only. You should leave this level as soon as soon as you can remember the rules.

60-79 Easy games. Use them to build proficiency.

40-59 Average games, but can be challenging. You'll lose a few.

30-39 Hard games. You'll have developed your own style by now and won't panic when a difficult situation arises. But you won't win them all.

20-29 Expert games. Just watching someone play one of these can boggle your mind. Losses will outnumber wins.

16-19 Nearly impossible games. Unless you are an air traffic controller already, it's possible that you'll never win one of these. But keep trying.

Sam, by the way, got a good night's sleep and promptly forgot his vow. Rumor has it that he succumbed to the lure of a level 19 game. I expect to hear the phone ring any minute. □

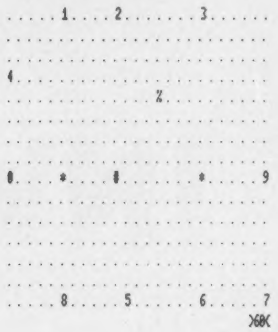
A Sample from Air Traffic Controller

Randy Heuer

One of my responsiblilities at Creative Computing is software review. As a result, I see a multitude of computer games. Most of them don't impress me. So when a simulation the quality of Air Traffic Controller comes along, I get very excited.

Now I know what you're thinking. "He's probably biased." Well, I'll give you a chance to form your own opinion. I'll play through a few minutes of Air Traffic Controller and let you see what an exciting simulation it really is.

It's important to remember that in Air Traffic Controller, a computer-assisted radar scope is portrayed on the computer's video display. This is a very dynamic medium and I can't possibly show you everything that occurs during the course of the game. Therefore I'll try to present the highlights of one game.



This is the mapboard for Air Traffic Controller (ATC.) The top of the screen is north. Each point on the map is one mile apart. The periods are simply mile markers. The numbers on the edges of the display are the entry/exit fixes. Aircraft may either enter or leave your control area via these points. The two asterisks are navigational aids (navaids.) These markers are extremely useful as aircraft can be ordered to circle about these markers automatically or instructed to assume an approach heading for either of the two airports. The airports are represented by the # and %. Aircraft must assume a westerly approach for the # airport and must land while travelling northwest for the % airport.

Aircraft are represented on the screen by their call letter (A-Z) and their altitude (0-9) in thousands of feet. There are no active aircraft on the screen at this time, but if aircraft F was at 6000 feet, it would be displayed as F6. An active aircraft is one that is presently in your control area. Aircraft which have not yet entered or have already left the area are called inactive.

The righthand side of the display is the aircraft status area. Information about aircraft to become active in your control area will be announced in the status area.

The following table lists the commands an aircraft can be given:

	A	L	R
0	clear to land	hold at navaid	continue straight ahead
1	ascend/descend to 1000'	turn left 45°	turn right 45°
2	ascend/descend to 2000'	turn left 90°	turn right 90°
3	ascend/descend to 3000'	turn left 135°	turn right 135°
4	ascend/descend to 4000'	turn left 180°	turn right 180°
5	ascend/descend to 5000'	clear for # approach	clear for % approach

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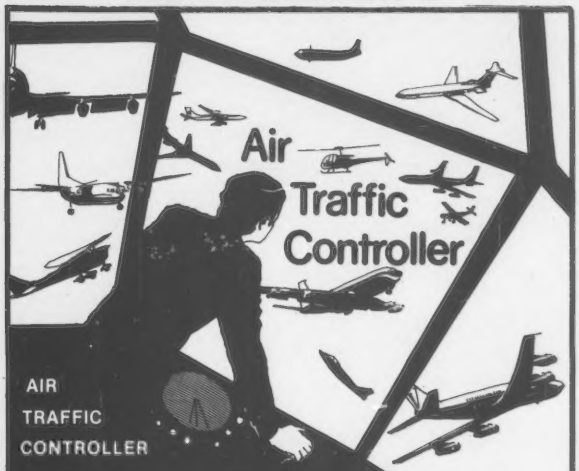

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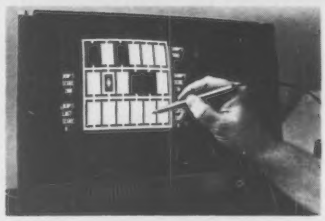

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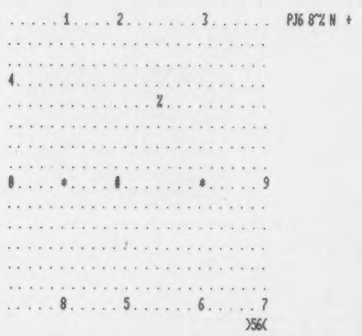
CIRCLE 149 ON READER SERVICE CARD

ATC, con't . . .

An aircraft is given an instruction by typing its call letter, the instruction letter (A,L or R) and instruction number (0-5). So, for example, to order aircraft Z to climb to 4000 feet, type ZA4. If your instruction is received properly, the pilot will respond "ROGER."

You may also request information on any aircraft (active or inactive) by typing its call letter. This is useful for obtaining information on aircraft which are presently active and are no longer displayed in the status information area.

That's a very brief overview of how the game is played. The object, of course, is to safely process all of the aircraft that enter your control area during the game. All of the restrictions discussed in David Mannering's article apply. I've selected a 60 minute game (as displayed on the clock in the lower right portion of the screen.) Remember, this is a real-time game. It's 0900:00 hours.



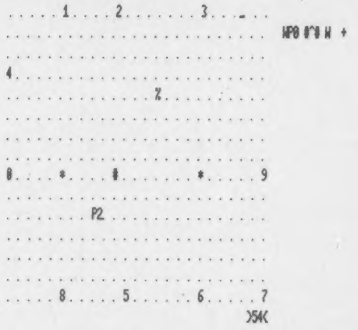
0904:00 - My first aircraft is about to become active. The status information area contains:

PJ6 8^% N +

This tells me that aircraft P is a jet (J) and is presently at 6000'(6). Aircraft P will enter my control area at fix 8 and has a destination of airport %. His present heading is north (N) and the + indicates that he has more than 10 minutes of fuel remaining. The aircraft will become active (on the screen) in one minute.

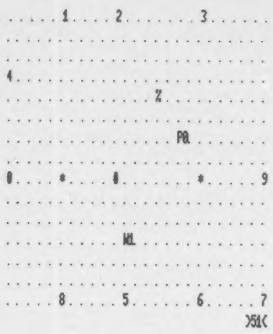
Jet aircraft fly at the rate of 4 miles/minute, so this aircraft will approach its destination fairly quickly. My strategy here is to order this aircraft to make a 45° right turn (PR1) and descend to 2000' (PA2). I'll allow it to continue straight ahead until it reaches the east-west line defined by the 0 and 9 fixes and order another 45° right turn (PR1). I'll then issue a clear for % approach (PR5), so when the aircraft reaches the rightmost navaid it will assume a landing heading for % airport. I'll then give him a final, clear to land (PA0) instruction.

This is typical of the type of planning that the air traffic controller must do the instant that a plane enters the status information area. Other aircraft which become active may force me to alter this plan, or if I make a mistake and forget to issue an instruction at the proper time, I may have to scramble in order to get the aircraft back to its intended destination. A serious mistake may end the game by causing one of the errors discussed in Mr. Mannering's article. Let's continue.

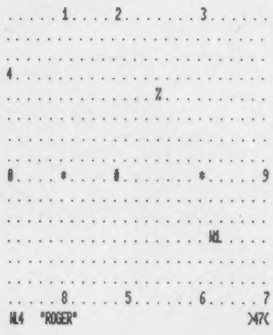


0905:30 - Another aircraft is about to become active. Aircraft W is practicing touch-and-go landings and wants to take-off from airport # and then land at the same airport. The problem here is that he must take-off and land in the same direction (west), so he must make a large circle. The P next to the W indicates that aircraft W is a prop plane flying at only 2 miles/min.

I'll order this aircraft to climb to only 1000'(WA1) and to make an immediate 180° left turn (WL4). When he flies far enough east, I'll instruct him to make another 180° left turn (WL4), clear him for approach to # (WL5) and then clear to land (WA0). Note that aircraft P has made the first right turn and is now heading northeast. He has also finished his descent to 2000' and in a moment. I must remember to order him to complete his second right turn in order to head for the navaid. I must be careful not to cause a conflict error between aircrafts P and W.

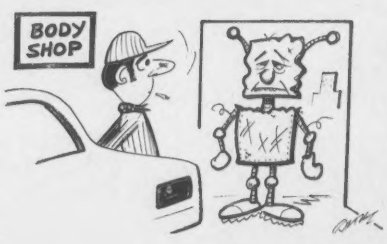


0909:00 - Another aircraft arrives. A jet, Q is about to enter through fix 7 with a destination of airport %. I'll order Q to descend to 2000'(QA2) and then a clear to approach %(QR5). Note that aircraft P is 30 seconds from landing at airport % (indicated by the 0 altitude). Aircraft W has finished his first 180° left turn and is heading east. I must be careful to keep aircraft Q above W until they are more than 3 miles apart to avoid a conflict error.



0913:15 - My first overflight arrives. Prop aircraft V will enter fix 3 with a destination of fix 6. He must exit at 5000' (WA5) but otherwise no other instructions need be issued. Since my last report, aircraft P and Q have landed. I've just issued aircraft W it's second 180° left turn instruction and the pilot has acknowledged it ("Roger").

I'm getting a bit nervous. Things have been too quiet for the first ten minutes with only four aircraft active.



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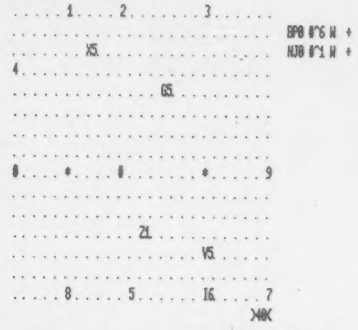
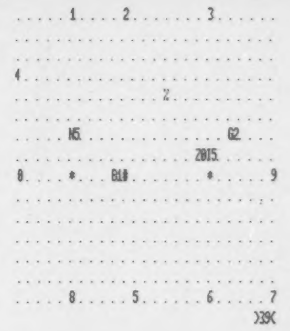
ATC, con't . . .

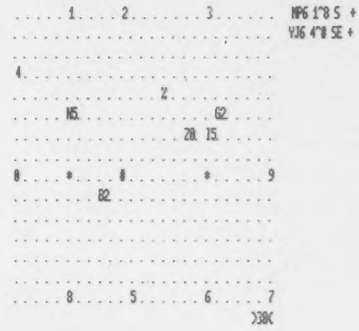
0918:00 - My fears are realized. Four aircraft arrive in the status information area simultaneously. Jet G wants to enter from fix 2 and land at airport #. This shouldn't prove to be too difficult. Prop B wants to take-off from # and exit fix 6 which is way across the map. Since a jet (Z) also wants to take-off from #, I'll hold B on the ground until the jet clears. Jet X wants to go from % to fix 1. This will involve a couple of quck turns, but isn't too bad. Jet Z however must take-off from # and land at %, probably arriving at the navaid about the same time as jet G. This could be very touchy. Note both W and V are on their proper headings and need not be given any further instructions, but must be taken into account in order to avoid conflict errors (particularly W). In this delicate situation, one small mistake will probably be fatal.



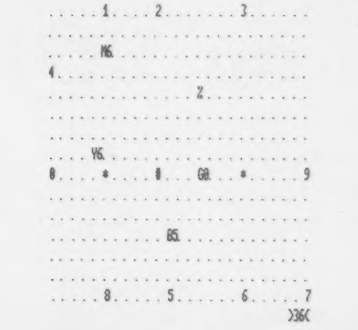
0920:00 - A very cluttered radar scope. Five aircraft are active at the present time (X, G, Z, V, I). A new arrival, I, wants to go from fix 6 to fix 3. Two aircraft are awaiting clearance to take-off, the latest being jet N which wishes to exit fix 1. I'll order him up shortly although prop B has been waiting several minutes. As I feared, both Z and G will arrive at the navaid almost at the same time. I'll probably have to order G into a holding pattern until the other traffic clears.



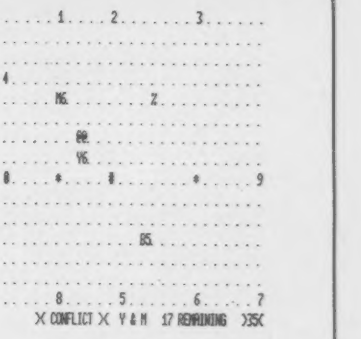
0921:45 - No new arrivals, but I just wanted to show what has happened since the last report. Aircraft X has exited successfuly. Z is on final approach and G is circling the navaid. Aircraft B and N are both in the air and aircraft I is heading for fix 3. Without any major new problems or mistakes I might survive.



0922:30 - Two new arrivals. I must be careful to leave them above 5000' until the other traffic has cleared. When G finishes this loop about the navaid, give him a clear to approach # instruction.



0924:30 - Things seem to be going well. I survived the onslaught. I think I now have a few moments to recover.



0925:30 - Well, I blew it. I relaxed for a moment and failed to notice that the two latest arivals (M, Y) were both at 6000' and I allowed them to get within three miles of each other causing a conflict error at the @ marker. Out of the 26 original aircraft, 17 failed to reach their destination. Fortunately, as in all computer simulations, everyone lives to fly another day.

I hope this brief, sample game has given you the flavor of this exciting, new, computer simulation. ATC combines the best of computer gaming with the strategy of board games, offering features that you won't find in either. More importantly, it's not the type of program that you'll tire of in a day or a week. You can always make the game more difficult. Every game is different. Every game is won or lost based on your decisions; not luck or chance. If you lose, it's because of a mistake you made.

Creative Computing Software is pleased to announce that Air Traffic Controller is now available for several popular microcomputer systems. Each tape is written in machine language and retails for $7.95 plus $2.00 postage and handling.
Air Traffic Controller

CS-3006 TRS-80 LEVEL II	16K
CS-4008 APPLE II	16K
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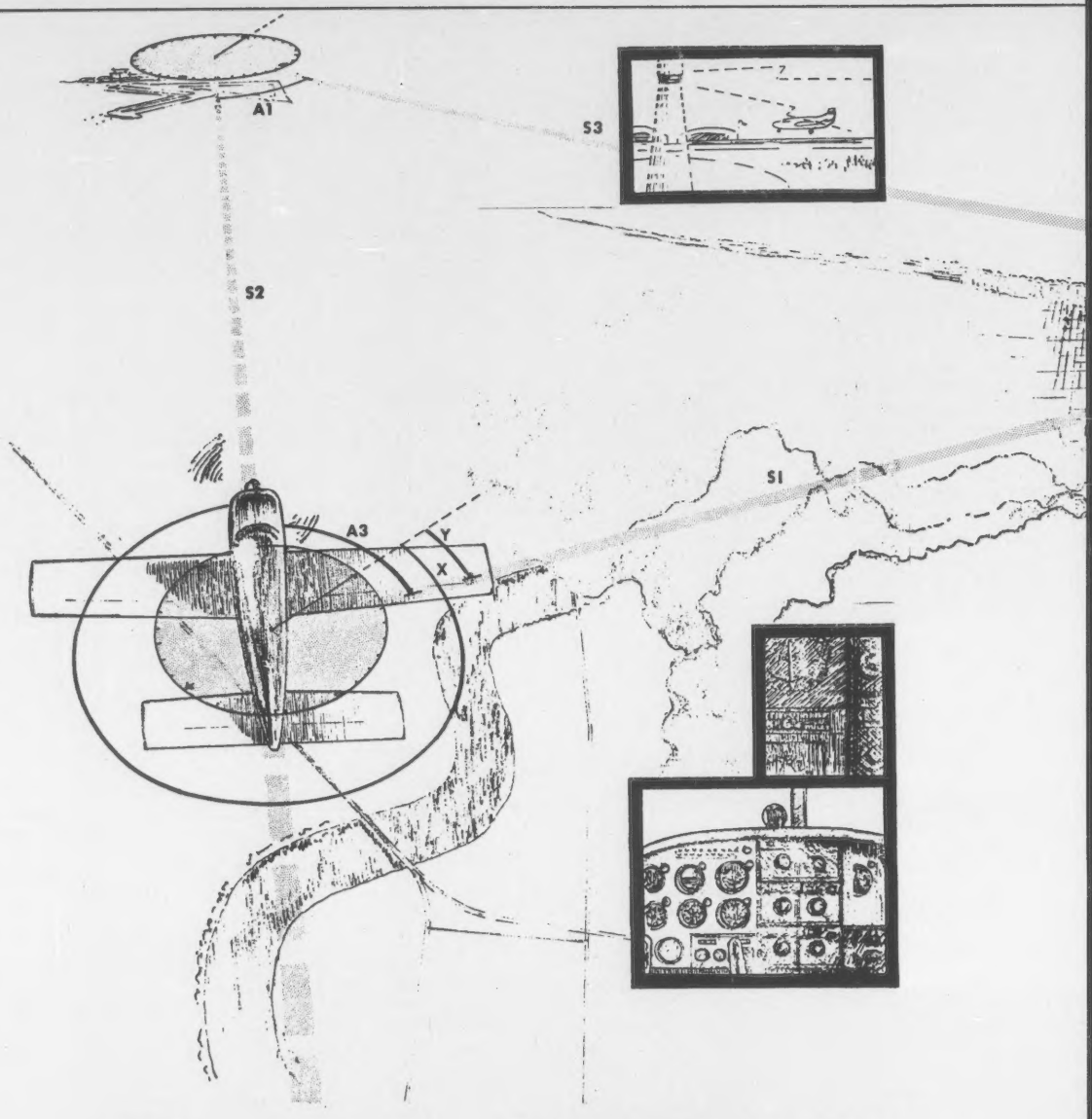
CS-8001 SOL-20	16K

In the future, look for Advanced Air Traffic Controller. This new version, by the original author, will be available for several of the machines listed above and will feature five different radar mapboards, an option that will allow you to replay the previous game, more restrictive and realistic boundary conditions and much more. Not intended for novices (like myself), this version will challenge even the most proficient controllers. □



Phantom VORTAC

This module will guide you in preparing the master program for an on-board flight computer. The computer takes information from a VHF omni range system (VORTAC), and calculates the magnetic course and distance to a given airport for the pilot. The output of the program is such that the pilot can fly toward a "phantom" VORTAC located at any airport he selects.

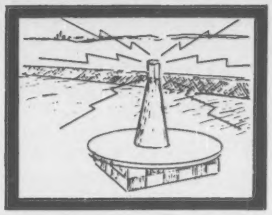
A description of this newly developed navigational system and the mathematics on which it is based are contained below along with alternate methods for handling the computation, and suggestions for ways in which previous programs you have written might be incorporated as sub-routines.

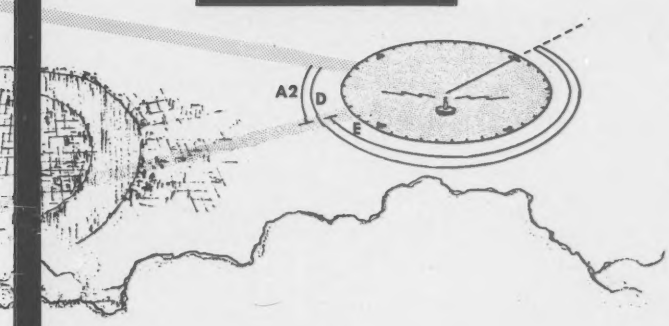
A "real time" simulation of a flight using this system is suggested as an advanced level program.

Pilots flying over the United States (and most other countries of the world) rely on radio facilities called VORTACs[1] for navigational information. The basic information the pilot receives in the cockpit is his position relative to the VORTAC, given in polar coordinates.

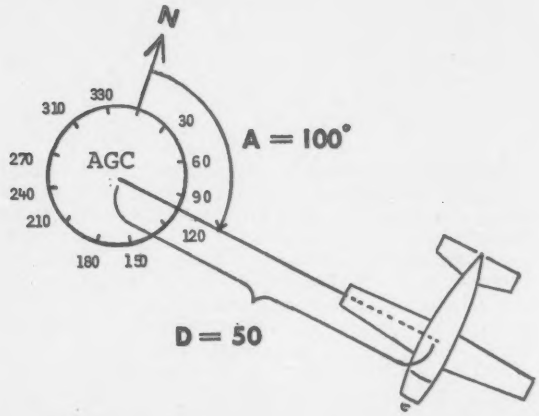
The pilot in the illustration below would describe his position (obtained from his radio instruments) as being "on the 100° radial of the Allegheny County (AGC) VOR, 50 miles out."

It is easy for this pilot to note that he can get to



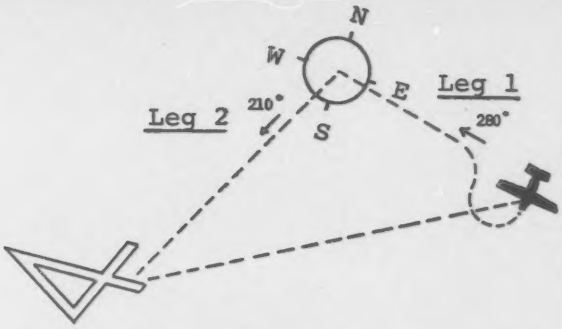


AGC by turning right, and flying a course[2] of 280° (Why 280°?). If he is going 200 miles per hour, it is also easy for him to estimate that he will arrive at AGC in 15 minutes (Is this exactly true?--go back over the article on vector addition if you are not sure.)



The catch to all of this is that the location of the VOR is usually different from the location of the destination airport. This difficulty can be handled by flying two legs, the first from the present position to the VOR, and the second from the VOR to the airport. This is obviously an inefficient route.

A new navigational system uses an on-board, special-purpose computer to tell the pilot what course and distance to fly in order to go directly from his present position to the airport. Let's first examine three ways of analyzing the mathematics involved in such a computation.

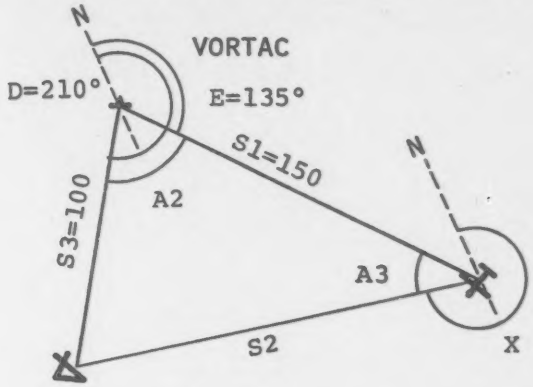


Before writing a program for such an on-board computer, it would be useful for a programmer to solve by hand typical problems arising in this situation.[3] At this point, let's look at three such solutions.

Problem1. The aircraft is 150 miles out on the 135° radial and the destination airport is 100 miles out on the 210° radial. That is, in the diagram, S1 = 150, E = 135°, S3 = 100, D = 210°.

Let A2 be the angle determined by S1 and S3. Hence, A2 = 210° - 135° = 75°. By the Law of Cosines,

$S2 = \sqrt{100^2 + 150^2 - 2 \cdot 100 \cdot 150 \cdot \cos(75°)} = 157.3$ miles. Now by the Law of Sines, $\frac{\sin A3}{} = (100 \cdot .966)/157.3 = .614$ and $\cos A3 = \sqrt{1 - .614^2} = .789$. From this we can get A3 = arctan (.614/.789) = 38°. (Why wasn't A3 computed directly from sin A3?) Therefore x = 135° + 180° - 38° = 277°. Output to the pilot is 157.3 miles, 277°--is this answer reasonable?



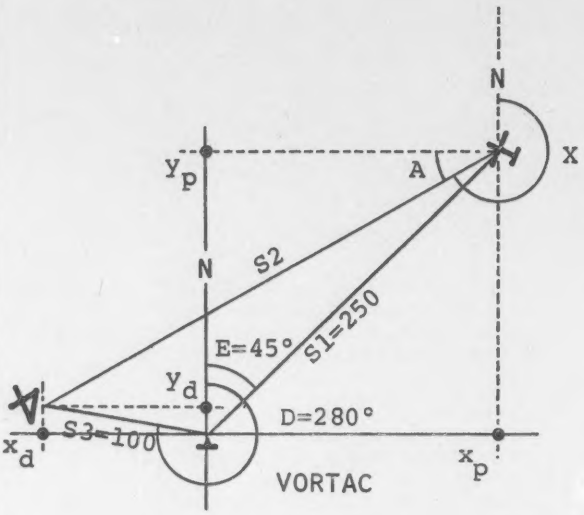
Problem 2. The airplane is 250 miles out on the 45° radial and the destination airport is 100 miles out on the 280° radial. In terms of the diagram, S1 = 250, E = 45°, S3 = 100, D = 280°.

Converting the positions of the aircraft and destination to rectangular coordinates with the VORTAC as origin we have

$x_p = 250 \sin 45° = 176.8$ miles,
$y_p = 250 \cos 45° = 176.8$ miles,
$x_d = 100 \sin 280° = -98.48$ miles,
$y_d = 100 \cos 280° = 17.36$ miles.

$$A = \arctan \frac{176.8 - 17.36}{176.8 - (-98.48)} = \arctan(.5792) = 30.1°$$

VORTAC, con't . . .

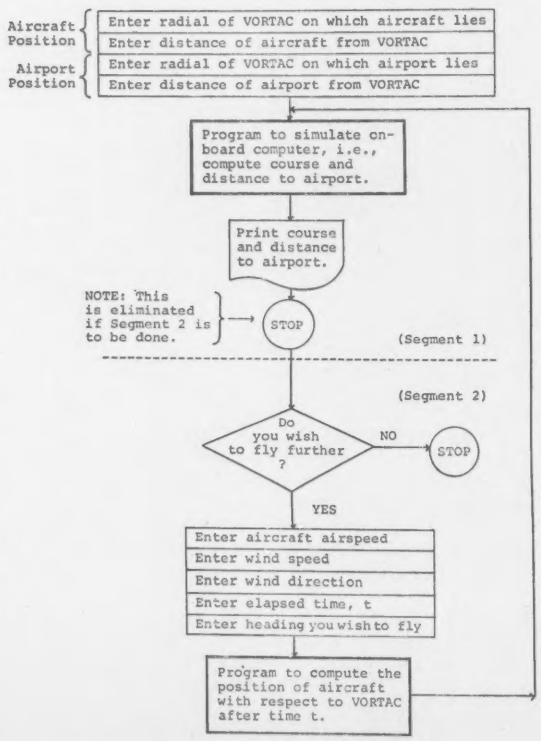


Therefore x = 270° - 30.1° = 239.9°. By the Pythagorean Theorem

$S2 = \sqrt{(176.8 - 17.36) + (176.8 - (-98.48))^2} = 318.1.$

Hence the output to the pilot is : 318.1 miles, 239.9°.

GROSS FLOW CHART FOR SUGGESTED ASSIGNMENTS


Aircraft Position
Enter radial of VORTAC on which aircraft lies
Enter distance of aircraft from VORTAC
Airport Position
Enter radial of VORTAC on which airport lies
Enter distance of airport from VORTAC
Program to simulate on-board computer, i.e., compute course and distance to airport.
Print course and distance to airport.
NOTE: This is eliminated if Segment 2 is to be done.
STOP
(Segment 1)
(Segment 2)
Do you wish to fly further ?
NO
STOP
YES
Enter aircraft airspeed
Enter wind speed
Enter wind direction
Enter elapsed time, t
Enter heading you wish to fly
Program to compute the position of aircraft with respect to VORTAC after time t.

Problem 3. The aircraft is 150 miles out on the 120° radial and the destination airport is 400 miles out on the 150° radial.[4] In the diagram, E = 120°, S1 = 150 miles, D = 150°, S3 = 400 miles. Using the same reasoning as in Problem 1 yields:

A2 = 30°

$S2 = \sqrt{400^2 + 150^2 - 2 \cdot 150 \cdot 400 \cdot \cos 30°} = 290.3$ miles

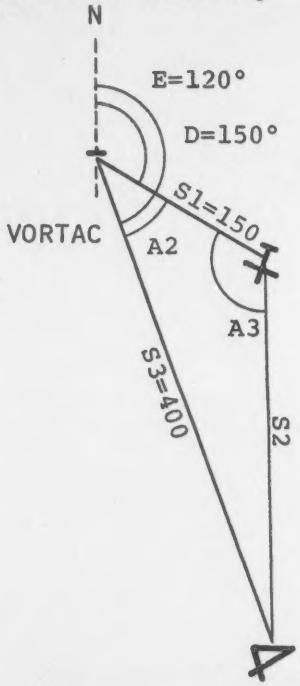
sin A3 = 400 (.5236/280.3) = .7135

$\cos A3 = \sqrt{1 - .7135^2} = .7007$

A3 = arctan (.7135/.7007) = 45.52°

X = 120° + 180° - 45.52 = 254.48°

Output to the pilot is 280.3 miles, 254.48°--does this answer look reasonable? What went wrong?



Assignment. Write a program for an on-board navigational computer which will accept as input the radial and distance from a VORTAC of both an aircraft and a destination, and which will compute a course and distance to the destination. The trigonometric subroutines in the computer require arguments in radians, but pilots think in terms of degrees, so it will be necessary for you to convert degrees to radians and back (see the module on converting to radians). Other possibly useful topics are inverse trigonometric functions, the Laws of sines and Cosines, and transformation of polar to rectangular coordinates[5].

Optional Section. During most flights, the aircraft moves through the air and the air moves as well. Write an addition to your program which will:

1. Accept as additional input, specified by the 'pilot,' (a) the aircraft's speed, (b) the speed of the wind, (c) the direction of the wind, (d) an elapsed time, t, and (e) a heading[6] for the aircraft. Any heading should be acceptable: the 'pilot' should be able to fly wherever he likes.

2. Compute the new position of the aircraft on the basis of the above information.

3. Repeat steps 1 and 2 as often as desired or necessary to reach the destination airport. □

1. Very high frequency Omni Range and TACAN, where TACAN is an older military system of distance measuring equipment. Most civilian pilots call these facilities VOR-DME stations.

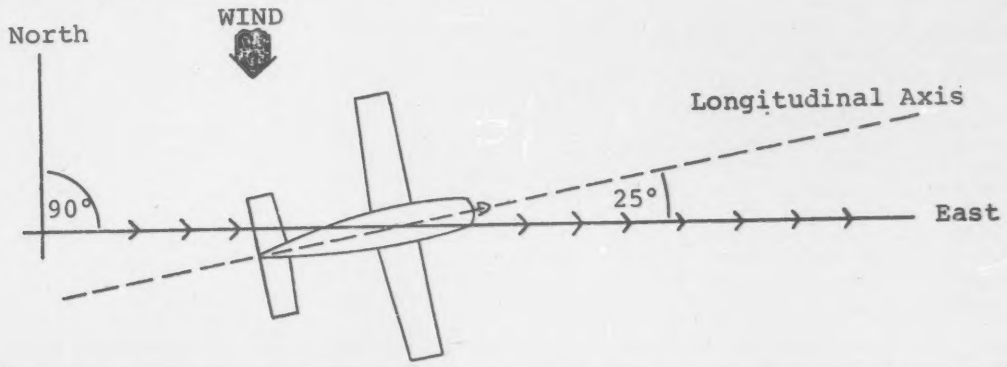
2. The angular direction of the intended flight path, measured clockwise from N.

3. This is another way of saying that computers do not remove the responsibility of analyzing a problem before solving it--quite the contrary; they demand more thought than ever. This may be, in fact, one of the most important contributions computing systems can make to learning.

4. By now you should have noticed that the word radial is used to designate the angular position of a line segment that starts at the VORTAC.

5. See previous articles.

6. Heading is defined as the angular direction of the longitudinal axis of the aircraft with respect to North. In the picture below, the pilot is flying a course of 90°, but his heading is 65°. Why?



This is a reprint of one of the original Project Solo curriculum modules developed at the University of Pittsburgh. Project Solo was supported in part by the National Science Foundation, and it was directed by Tom Dwyer and Margot Critchfield. The modules were authored by various persons, including project staff, teachers, and students.

It should be kept in mind that Project Solo began in 1969 (which is probably before some of Creative's readers were born.) Undoubtedly, many of the modules would be done differently today. There are also surely errors to be found, and neither Creative Computing, the authors, or NSF can warrant the accuracy of the reprints. But as a starting point for your own explorations, they should make a good (albeit slightly ancient) set of shoulders to stand upon. We hope you enjoy the view.

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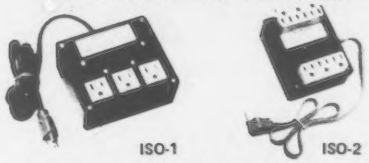

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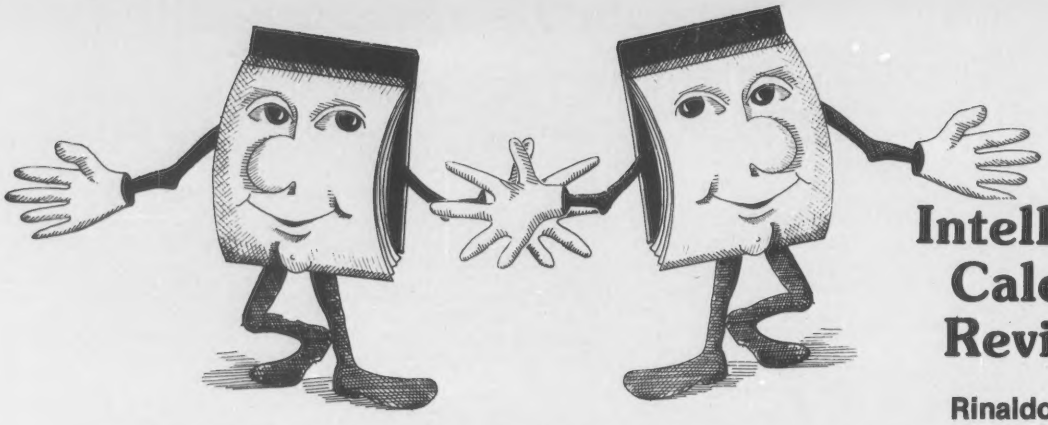


Intelligent Calendar Revisited

Rinaldo F. Prisco

I am writing to comment on Gary Young's program in the article, "An Intelligent Calendar for Every Home," vol. 5, no. 4, page 128.

The concept of such a calendar is a very good one. (Why is it that most magazine programs that interest me appear in **Creative Computing**?) There are, however, a number of places where the program can be improved quite a bit. Some of them just involve avoiding time consuming loops, others are to correct erroneous results. Rather than list all the line additions, corrections, or deletions, I am enclosing a modified and revised program which is about 1K shorter, much faster, and allows almost twice the number of descriptions in 80% of the disk space. Some of the changes are:

- The leap year routine resulted in incorrect calendars since leap years are taken care of in line 15400; thus the GOSUB in line 7700 is replaced by A(2) = 29.
- The "+1" in line 14900 would have eliminated the week where the end of the month is a Sunday; it has been removed.
- The only time the revised program checks for descriptions (a time consuming loop) is during the second line of calendar days and lines of calendar days where the preceeding line contained a description.
- Payment-balance data and computations have been taken out to allow for twice as many descriptions. The important thing to know about payments is when they are due so they can be (hopefully) paid in time. The bill contains all the information.
- Byte access has been used for disk storage for the month and day (using 2 bytes rather than 10). We could be even more space efficient and use it for the frequency as well but care must be exercised since North Star data files use &1 for the EOF mark. Five blocks can now hold 70 descriptions instead of 6 blocks holding 40 descriptions.
- The CREATE routine will now actually create file space if it was not previously created.
- Modifications for data input and READ have been made.
- An insert has been inserted between succeeding printouts of months to allow time for adjustment of the paper on the printer.
- All printouts other than the calendar itself are to the CRT.

Rinaldo F. Prisco, R.D. #7, Edgebrook, Oswego, NY 13126.

```
1800 REM   MODIFICATION AND REVISION OF PROGRAM BY
1850 REM             GARY YOUNG
1852 REM   CREATIVE COMPUTING  APRIL 1979
1856 REM
1858 REM   MODIFICATION AND REVISION BY
1860 REM         RINALDO F. PRISCO
1862 REM       ALL RIGHTS RESERVED
1864 REM
1900 DIM B$(9),A(12),T(12),D$(63),M$(108)
2000 REM ARRAYS ARE SET FOR 70 DESCRIPTIONS
2100 DIM D9$(630),D9(70,4)
2200 DIM L(7,2)
2300 DATA 31,28,31,30,31,30,31,31,30,31,30,31
2400 DATA 0,31,59,90,120,151,181,212,243,273,304,334
2500 DATA " SUNDAY"
2600 DATA " MONDAY"
2700 DATA " TUESDAY"
2800 DATA "WEDNESDAY"
2900 DATA " THURSDAY"
3000 DATA " FRIDAY"
3100 DATA " SATURDAY"
3200 DATA " JANUARY"
3300 DATA " FEBRUARY"
3400 DATA "  MARCH"
3500 DATA "  APRIL"
3600 DATA "    MAY"
3700 DATA "   JUNE"
3800 DATA "   JULY"
3900 DATA "  AUGUST"
4000 DATA "SEPTEMBER"
4100 DATA " OCTOBER"
4200 DATA "NOVEMBER"
4300 DATA "DECEMBER"
4400 FOR N=1 TO 12:READ A(N):NEXT N
4500 FOR N=1 TO 12:READ T(N):NEXT N
4600 FOR N=0 TO 6:L=N*9-1:READ D$(L):NEXT N
4700 FOR N=0 TO 11:L=N*9+1:READ M$(L):NEXT N
4750 INPUT "Enter name of data file: ",D1$
4800 !"ENTER CREATE, ADD, CHANGE, DELETE, LIST OR RUN? "
4900 INPUT "",F$
5000 IF LEN(F$)=0 THEN END
5100 IF F$="CREATE" THEN 24600
5200 IF F$="ADD" THEN 26500
5300 IF F$="CHANGE" THEN 27200
5400 IF F$="DELETE" THEN 27200
5500 IF F$="LIST" THEN 29300
5600 IF F$="RUN" THEN 5900
5700 !"INVALID COMMAND"
5800 GOTO 4800
5900 OPEN #1,D1$
6000 J=0
6100 IF TYP(1)=0 THEN 7400
6200 J=J+1
6300 READ #1,B$,&D9(J,1),&D9(J,2),D9(J,3)
6700 IF B$<>"DELETED  " THEN 7000
6800 K=K-1
6900 GOTO 6100
7000 D9(J,4)=0
7100 K=(J-1)*9+1
7200 D9$(K,K+8)=B$
7300 GOTO 6100
7400 N8=J
7500 !"ENTER STARTING YEAR, MONTH AND NO. OF MONTHS ",
7600 INPUT "",Y9,M9,N9
7700 IF Y9=INT(Y9/4)*4 THEN A(2)=29
7800 REM IT WILL TAKE A FEW SECONDS TO ADVANCE THE DATES
7900 REM DON'T THINK THE SYSTEM IS HUNG UP
```

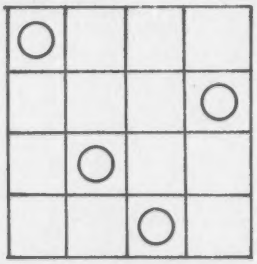
```
8000 GOSUB 22600
8100 M9=M9-1
8200 N1=0
8300 N1=N1+1
8400 IF N1<=N9 THEN 8500:!#P,CHR$(7),:END
8500 M9=M9+1
8600 IF M9<13 THEN 8800
8700 M9=1:Y9=Y9+1
8800 Y7=Y9
8900 M7=M9
9000 D9=1:D7=1
9100 GOSUB 15200
9200 IF W7>1 THEN D9=D9-W7+1
9300 REM PRINT HEADINGS
9350 INPUT "PRESS RETURN WHEN SELECTRIC IS READY.
9400 !#P:!#P:!#P                                    ",Z$:P=2
9500 FOR J=1 TO 70:!#P,"#",:NEXT J
9600 !#P:!#P:!#P,TAB(24),
9700 FOR J=1 TO 9:K=(M9-1)*9+J:!#P," ",M$(K,K),:NEXT J
9800 !#P,"  19",%2I,Y9:!#P
9900 FOR J=0 TO 6:K=J*9+1:!#P," ",D$(K,K+8),:NEXT J
10000 !#P
10100 FOR J=1 TO 71:!#P,"*",:NEXT J:!#P
10200 REM PRINT BODY OF CALENDAR
10300 N2=1:FOR J=1 TO 7:F(J)=1:NEXT:GOTO 10700
10400 N2=N2+1
10500 REM N2 IS THE NUMBER OF LINES IN DAY BOX
10600 IF N2>7 THEN 13200
10700 S=0
10800 T=-10
10900 REM D1 IS THE CURRENT DAY IN THE MONTH
11000 D1=D9
11100 REM T IS THE TAB POSITION
11200 T=T+10
11300 REM S IS THE DAY OF THE WEEK COUNTER
11400 S=S+1
11500 !#P,TAB(T),"*",
11600 IF T>69 THEN 12700
11700 REM ON THE FIRST LINE OF THE WEEK, PRINT THE DATE
11800 IF D1<1 OR D1>A(M9) THEN 12500
11900 IF N2>1 THEN 12300
12200 !#P,TAB(T+5),%2I,D1,
12300 IF N2>1 AND F(S)=1 THEN GOSUB 20000
12500 D1=D1+1
12600 GOTO 11200
12700 !#P
12800 GOTO 10400
12900 REM
13000 REM AT END OF WEEK, PRINT FULL BOTTOM LINE AND
13100 REM                                   CLEAR FLAGS
13200 FOR J=1 TO 71:!#P,"*",:NEXT J:!#P
13300 FOR J=1 TO N8:D9(J,4)=0:NEXT J
13400 REM
14700 D9=D9+7:IF D9>A(M9) THEN 8300 ELSE 10300
15200 REM CALCULATE THE DAY OF THE WEEK
15400 T7=INT(D7+365.25*Y7+T(M7)+.01*M7-.03)
15500 W7=T7-INT((T7-1)/7)*7
15600 W7=W7+1
15700 IF W7=8 THEN W7=1
15800 RETURN
16000 REM INCREMENT TO NEXT PERIOD
16200 M=D9(Q,1):D=D9(Q,2):F=D9(Q,3)
16600 IF F<>2 THEN 17100
16700 M=M+6
16800 IF M>12 THEN M=M-12
16900 IF D>A(M) THEN D=A(M)
17000 GOTO 19600
17100 IF F<>4 THEN 17400
17200 M=M+3
17300 GOTO 16800
17400 IF F<>12 THEN 17700
17500 M=M+1
17600 GOTO 16800
17700 IF F<>24 THEN 18400
17800 IF D<>A(M) THEN 18200
17900 D=15
18000 M=M+1
18100 GOTO 16800
18200 IF D=15 THEN D=A(M)
18300 GOTO 19600
18400 IF F<>26 THEN 18900
18500 D=D+14
18600 IF D<=A(M) THEN 19600
18700 D=D-A(M)
18800 GOTO 17500
18900 IF F<>52 THEN STOP
19000 D=D+7
19100 GOTO 18600
19600 D9(Q,1)=M:D9(Q,2)=D
19700 RETURN
19900 REM PRINT DESCRIPTION
20000 FOR Q=1 TO N8
20100 IF D9(Q,4)=1 OR M9<>D9(Q,1) OR D1<>D9(Q,2) THEN
                                                21300
20400 N=(Q-1)*9+1:IF D9(Q,3)>1 THEN GOSUB 16000
20500 !#P,D9$(N,N+8),
20600 D9(Q,4)=1:EXIT 21400
21300 NEXT Q:F(S)=0
21400 RETURN
22300 REM M5 IS THE MONTH OF THE EARLIEST DATE IN THE DATA
22400 REM IT IS USED TO CALCULATE FORWARD TO A LATER DATE
22500 REM DATA WITH A MONTH PRIOR TO M5 IS CONSIDERED AS
22550 REM NEXT YEAR
22600 M5=1
22700 FOR Q=1 TO N8
22800 IF D9(Q,3)=1 THEN 23800
22900 IF M5>M9 THEN 23400
23000 IF D9(Q,1)<M9 THEN 23100 ELSE 23800
23100 IF D9(Q,1)<M5 THEN 23800
23200 GOSUB 16200
23300 GOTO 23000
23400 IF D9(Q,1)<M9 THEN 23600
23500 IF D9(Q,1)<M5 THEN 23800
23600 GOSUB 16200
23700 GOTO 23400
23800 NEXT Q
23900 RETURN
24600 REM CREATE CALDATA FILE
24650 IF FILE(D1$)=-1 THEN CREATE D1$,5
24700 OPEN #1,D1$
24800 K=0
25100 !:!"ENTER ONLY CARRIAGE RETURN ON DESCRIPTION TO END":!
25200 K=K+1
25300 !%2I,K,") ",
25400 INPUT1 " DESC? ",B$:IF LEN(B$)=0 THEN 26300:!TAB(26),
25500 INPUT1 "MONTH? ",S1:!TAB(40),:INPUT1 "DAY? ",S2
25600 !TAB(53),:INPUT1 "FREQ.? ",F1:!
25700 GOSUB 30600
25800 IF E9>0 THEN 25300
25900 D9$(1,9)="         "
26000 D9$(1,9)=B$
26100 WRITE #1,D9$(1,9),&S1,&S2,F1
26200 GOTO 25200
26300 CLOSE #1:!:!
26400 GOTO 4800
26500 REM ADD ENTRIES TO BOTTOM OF DATA LIST
26600 OPEN #1,D1$
26700 K=0
26800 IF TYP(1)=0 THEN 25100
26900 READ #1,B$,&S1,&S2,F1
27000 K=K+1
27100 GOTO 26800
27200 REM CHANGE OR DELETE CODE
27300 REM A DELETE IS JUST A CHANGE WITH THE DESC=DELETE
27400 OPEN #1,D1$
27500 !"ENTER RECORD NO 0 TO TERMINATE"
27600 INPUT "RECORD NO? ",R
27700 IF R=0 THEN 26300
27800 J=(R-1)*18
27900 READ #1 %J,B$,&S1,&S2,F1
28000 IF F$="CHANGE" THEN 28400
28100 B$="DELETED  "
28200 WRITE #1 %J,B$,&S1,&S2,F1,NOENDMARK
28300 GOTO 27600
28400 INPUT1 " DESC? ",B$:IF LEN(B$)=0 THEN 26300:!TAB(26),
28500 INPUT1 "MONTH? ",S1:!TAB(40),:INPUT1 "DAY? ",S2
28600 !TAB(53),:INPUT1 "FREQ.? ",F1:!
28700 GOSUB 30600
28800 IF E9>0 THEN 28400
28900 D9$(1,9)="         "
29000 D9$(1,9)=B$
29100 B$=D9$(1,9)
29200 GOTO 28200
29300 REM LIST THE FILE
29400 OPEN #1,D1$
29500 K=0
29600 !
29700 !TAB(15)," NO.  DESCRIPTION   START   FREQ"
29800 IF TYP(1)=0 THEN 30400
29900 READ #1,B$,&S1,&S2,F1
30000 K=K+1:IF K<>INT(K/14)*14 THEN 30100
30050 !CHR$(12),:INPUT1"",Z$:!CHR$(13),
30100 !TAB(15),%3I,K,"    ",B$(1,9),"    ",%2I,S1,"/",S2,
30200 !"    ",%2I,F1
30300 GOTO 29800
30400 REM
30500 GOTO 26300
30600 REM EDIT THE INPUT DATA
30700 E9=0
31000 IF S1<1 OR S1>12 THEN 32100
31200 IF S2<1 OR S2>A(S1) THEN 32100
31400 IF F1=1 OR F1=2 OR F1=4 OR F1=12 THEN RETURN
31800 IF F1=24 OR F1=26 OR F1=52 THEN RETURN
32100 !"ERROR IN DATA"
32200 E9=1
32300 RETURN
```

Checkerboard Problem Solved

In the September 1979 issue (page 152) Donald Piele presented the following problem from a recent programming contest.

1. Patterns

A. Suppose you have a 4 -by- 4 checkerboard and four checkers. You are to place the four checkers on the checkerboard in such a way that each of the four rows, four columns, and two main diagonals contains exactly one checker. One such example is the following pattern:



You are to write a program to print **all** the possible 4 -by- 4 checkerboard patterns which conform to the above rules. Each pattern should be displayed with a star (*) in the position of a checker, and a dot (.) in the position of a space. For example, the above pattern should be displayed as follows:

```
* . . .
. . . *
. * . .
. . * .
```

(Hint: To make the display more readable, you should print a blank between each of the characters on a line.)

B. More generally, your program should work for **any** n-by-n checkerboard, with the n checkers placed such that each of the rows, columns and two main diagonals contains exactly one checker. Your program should allow for input of the size n of the checkerboard. Each run should end by printing the total number of successful patterns found. The program should also request from the user whether the patterns themselves should be displayed; if not, **only** the **number** of successful patterns should be printed.

Test your program with n = 3, n = 4 and n = 5 checkers. Include displays of the actual patterns for n = 4, but do not include them for n = 3 or n = 5.

Geoffrey Chase, OSB of Portsmouth Abbey, Portsmouth, RI 02871 writes, "I found the problem to be a real stinker. The enclosed program exemplifies the technique of recursive descent used by nearly every syntax parsing routine. It is, in a sense, mathematical induction."

```
100 REM.        Checkerboard problem in Creative Computing 9/1979
110 !           P.A.S.  September '79
120 DIM C(20),R(20)
130 PRINT "CHECKBOARD HAS 'N' ROWS, 'N' COLUMNS.  TYPE VALUE OF 'N'";
140 INPUT N
150 PRINT "SHALL I PRINT THE SOLUTIONS ";: INPUT S$
160 S$=MID(S$,1,1): IF S$<>"Y" THEN NO=1
170
180 L=0: S=0                        ! level (row), no. of solutions
190 GOSUB 260
200 PRINT: PRINT,"THERE WERE **";S;"** SOLUTIONS."
210 STOP
220
230 !-----------< SUBROUTINE >-------------
240 REM.                    Descend one level:
250 R(L)=J                          ! push J onto stack
260 L=L+1: IF L<=N THEN 410         ! not below bottom yet
270
280 !           ---------------------
290 S=S+1                           ! bump solution counter
300 IF NO THEN 600                  ! NO=1 for no print-out
310 PRINT
320 FOR K=1 TO N: PRINT
330 FOR K2=1 TO N
340 IF C(K2)=K THEN PRINT USING "### ",K;: GOTO 360
350 PRINT " .. ";
360 NEXT K2
370 NEXT K
380 GOTO 600
390 !           ---------------------
400
410 J=0
420 J=J+1                           ! try next column
430 IF J>N THEN RETURN              ! we've come too far, no column is free
440 IF C(J)>0 THEN 420              ! this column already taken
450
460 REM.                    Check main diagonal:
470 IF J<>L THEN 520                ! not on main diagonal
480 FOR K=1 TO L-1
490 IF C(K)=K THEN 420              ! no room for us on main diagonal
500 NEXT K
510 REM.                    Check reverse diagonal:
520 IF J<>N+1-L THEN 570            ! not on reverse diagonal
530 FOR K=1 TO L-1
540 IF C(N+1-K)=K THEN 420          ! no room for us on reverse diagonal
550 NEXT K
560
570 C(J)=L                          ! this column is free, grab it
580 GOSUB 250                       ! descend
590
600 L=L-1: IF L<=0 THEN RETURN
610 FOR K=1 TO N: IF C(K)>=L THEN C(K)=0        ! scrub out leftovers
620 NEXT K
630 J=R(L)                          ! pop J from stack
640 GOTO 420
650 !-------------------------------------
660
670 END
```

Problem, con't . . .

Steve North comments that the problem could be solved by exhaustive analysis. On an N x N board the number of trials would be:

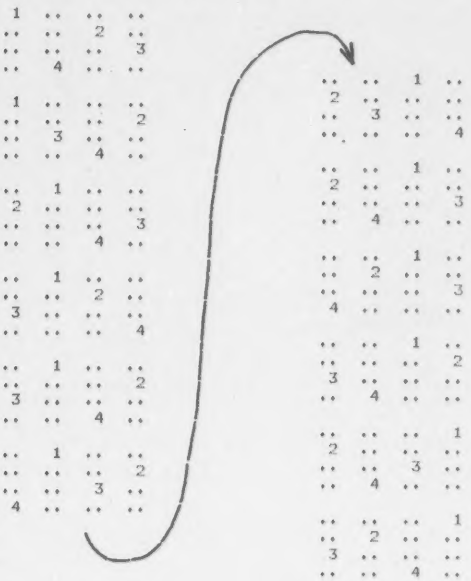
$$\frac{N^2!}{N!(N^2 - N)!}$$

which for 5 is:

$$\frac{25!}{5!\ 20!} = \frac{25 \cdot 24 \cdot 23 \cdot 22 \cdot 21}{5 \cdot 4 \cdot 3 \cdot 2} = 53{,}130$$

53,130 possibilities to consider might be okay on a large mainframe, but not on anything smaller.

```
CHECKBOARD HAS 'N' ROWS, 'N' COLUMNS.  TYPE VALUE OF 'N'? 4
SHALL I PRINT THE SOLUTIONS ? YES
```




```
 1  ..  ..  ..
 ..  ..  2  ..
 ..  ..  ..  3
 ..  4  ..  ..

 1  ..  ..  ..
 ..  ..  ..  2
 ..  3  ..  ..
 ..  ..  4  ..

 ..  1  ..  ..
 2  ..  ..  ..
 ..  ..  ..  3
 ..  ..  4  ..

 ..  1  ..  ..
 ..  ..  2  ..
 3  ..  ..  ..
 ..  ..  ..  4

 ..  1  ..  ..
 ..  ..  ..  2
 3  ..  ..  ..
 ..  ..  4  ..

 ..  1  ..  ..
 ..  ..  ..  2
 ..  ..  3  ..
 4  ..  ..  ..

 ..  ..  1  ..
 2  ..  ..  ..
 ..  3  ..  ..
 ..  ..  ..  4

 ..  ..  1  ..
 2  ..  ..  ..
 ..  ..  ..  3
 ..  4  ..  ..

 ..  ..  1  ..
 ..  2  ..  ..
 ..  ..  ..  3
 4  ..  ..  ..

 ..  ..  1  ..
 ..  ..  ..  2
 3  ..  ..  ..
 ..  ..  4  ..

 ..  ..  ..  1
 2  ..  ..  ..
 ..  ..  3  ..
 ..  4  ..  ..

 ..  ..  ..  1
 ..  2  ..  ..
 3  ..  ..  ..
 ..  ..  4  ..

THERE WERE ** 12 ** SOLUTIONS.
```

```
STOP AT LINE 210
READY

RUN

CHKRBD  EDUCOMP BASIC V4.3  26-SEP-1979

CHECKBOARD HAS 'N' ROWS, 'N' COLUMNS.TYPE VALUE OF 'N'? 6
SHALL I PRINT THE SOLUTIONS ? NIX


            THERE WERE ** 368 ** SOLUTIONS.

STOP AT LINE 210
READY

RUN

CHKRBD  EDUCOMP BASIC V4.3  26 SEP-1979

CHECKBOARD HAS 'N' ROWS, 'N' COLUMNS.TYPE VALUE OF 'N'? 5
SHALL I PRINT THE SOLUTIONS ? NEGATIVE

            THERE WERE ** 68 ** SOLUTIONS.

STOP AT LINE 210
READY
```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(frā'kas) n.l. a noisy dispute or fight; loud quarrel or disturbance; brawl; 2. a fantastic computer adventure challenging any number of players to explore a secret maze packed with hidden treasure, guarded by wily adversaries...

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CIRCLE 127 ON READER SERVICE CARD

These two pages are reprinted from "The I Hate Mathematics Book" by Marilyn Burns, illustrated by Martha Hairston. The books in this series come from a group of California teachers, writers, and artists who get together to work every now and then on stuff for kids and to have a good time. The books reflect this approach and really make learning fun. Printed on brown paper, paperback, only $3.95 from Creative Computing Book Service.

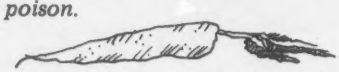
POISON - A FRIENDLY GAME

You need:

A friend,

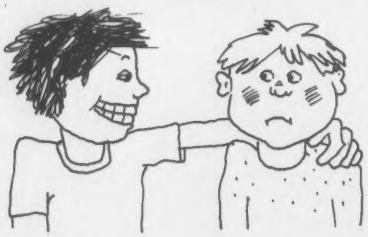
12 things that are the same — like beans, or nails, or bottlecaps and

one more thing that is different — the *poison.*



Say to your friend:

"How about a friendly game of *poison?*"



Take turns.

When your turn comes you must take away 1 thing, or 2 things, until only the poison is left..

Whoever takes away the poison, *dies.*

How can you always avoid the poison?

You'll have to figure that out. (We can't tell you *everything!* But it's possible.)

Some hints. (Well, questions, really.)

Is it better to go 1st or 2nd?

What would happen if there were a different number of things?

How would it be if you could take away 1 or 2 or 3 things?

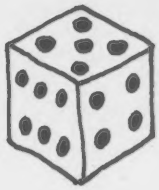
If you play enough, you'll figure it out.

THIS GAME IS 1 OF A VARIETY CALLED NIM-TYPE GAMES. HERE IS ANOTHER VERSION YOU CAN PLAY WITH TOOTHPICKS. YOU'LL NEED 16, ARRANGED LIKE THIS:

|||||||	(7)
|||||	(5)
|||	(3)
|	(1)

ON YOUR TURN, TAKE AS MANY AS YOU WANT, BUT ONLY FROM 1 ROW. WHOEVER TAKES THE LAST ONE LOSES.

Long-time readers of *Creative Computing* might recognize that PIG is a pencil-and-paper version of NOT ONE which appeared back in Vol. 1, Nos. 1 and 3 of *Creative*.



PIG

Here is a good game. It depends on knowing a little something about probability as well as not being too much of a pig.

You need 2 dice, a friend, and a paper and pencil (unless you are terrific at adding numbers in your head).

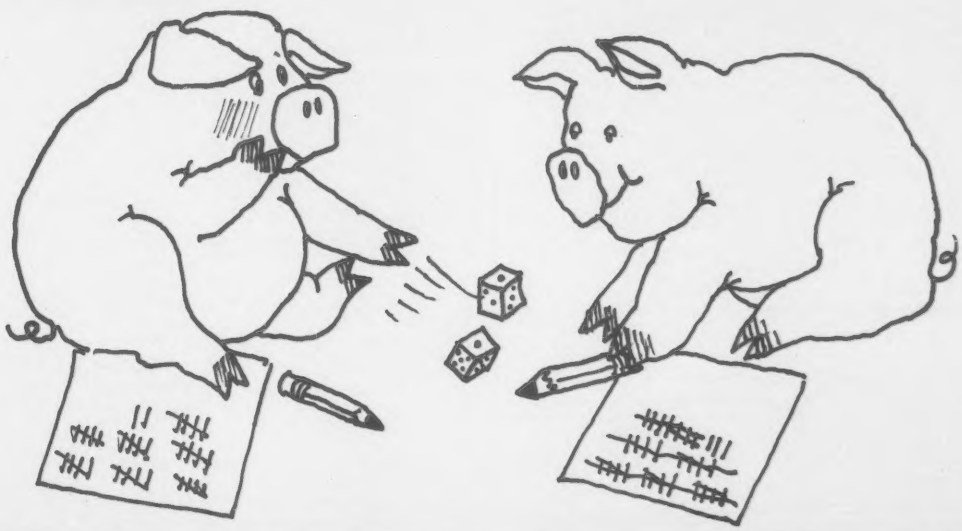
You roll the dice and add up what they say. The idea is to get to 100. You don't have to take turns. You keep rolling as long as you want. BUT:

If a 1 comes up on 1 of the dice, you lose your count for that turn.

If a 1 comes up on both dice, your total goes back to 0. (Even if you were at 98!) And anytime you throw a 1, you lose your turn.

It helps a lot to know how to add. But it helps even more if you can predict how often 1's will come up. What is the probability of throwing one 1? What is the probability of throwing snake eyes (two 1's)?

What is a lucky streak? Do you know one when you have it?



APPLE II

Space Games-1, CS-4001 (16K)

Haunted House, CS-4005 (16K)

HAUNTED HOUSE
YOU ARE IN THE PLAY ROOM
YOU BRUSH A LARGE SPIDER OFF YOUR ART
WHICH DESCENDED FROM THE CEILING
AT THE END OF THE ROOM IS A DOOR
BEHIND YOU IS A DOOR

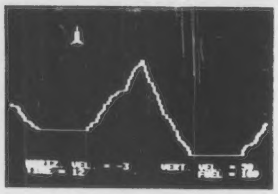
It is 6:00 and you have until midnight to find the secret passageway out of a haunted house. During your search, you may find skeleton keys to open locked doors, good luck charms, friendly ghosts, evil spirits, and skeletons. The sound effects (creaking doors and stairs) add to the eeriness. The house layout changes in every game.

1. Saucer Invasion

We're being invaded by aliens from another planet. Your mission is to destroy as many saucers as possible with 15 missiles. Use the game paddle to move the launch tube back and forth across the bottom of the screen, then fire with the paddle button. A two stage missile boosts slowly, firing its warhead midway toward the target. The flying saucers fly at different speeds and altitudes, so luck and timing are crucial! High resolution graphics, exploding saucers and wild sound effects make full use of the APPLE capabilities.

2. Rocket Pilot

Rocket Pilot is an advanced real time take off and landing game. The object is to maneuver your spaceship successfully



over a mountain to the landing area on the other side. The game paddles control your horizontal and vertical thrusters. In addition to the graphics display of the rocket, the screen also shows your current velocity, time, and remaining fuel. Earn a rating of "rocket pilot" if you negotiate the trip without running out of fuel or crashing into the mountain.

3. Dynamic Bouncer

Watch a ball move through a maze of colorful, changing obstacles in this creative graphics demonstration.

4. Star Wars

Use the game paddles to get the enemy TIE fighters within your crosshairs, then FIRE!! The object is to destroy as many enemy ships as possible in 90 seconds as they perform evasive maneuvers to avoid your fire.

Lasers, exploding enemy fighters, and action sounds put you in the middle of the fierce battle against the Imperial Empire!

Apple Software on Disks

Now, Creative Computing offers its cassette software of floppy disks. These are not just the same programs stored on a disk but enhanced, menu driven libraries for the ultimate in ease of use. The machine language programs have been relocated to run with your disk system, and even Applesoft programs are loaded and executed automatically. Make the most of your APPLE with Creative Computing floppy disk software.

SPACE AND SPORTS GAMES CS-4501

- Rocket Pilot
- Saucer Invasion
- Star Wars
- Dynamic Bouncer
- Baseball
- Torpedo Alley
- Slalom
- Darts

STRATEGY AND BRAIN GAMES CS-4502

- Checkers
- Skunk
- UFO
- Blockade
- Genius
- Nuclear Reaction
- Dodgem
- Dueling Digits
- Parrot
- Midpoints
- Lines
- Tones

CAI PROGRAMS AND KNOW YOURSELF CS-4503

- U.S. Map
- Spelling
- Math Drill
- Add-With-Carry
- Life Expectancy
- Psychotherapy
- Computer Literacy
- Alcohol
- Sex Role

How To Order

Creative Computing Software should be stocked by your local retail computer store. If your favorite retailer does not have the software you need, have him call our retail marketing dept. at 800-631-8112. (In NJ,201-540-0445).

Or you can order directly from Creative Computing. Use the handy order form on page 133.

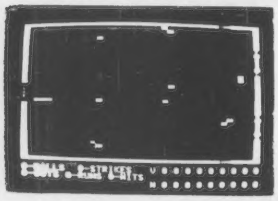
sensational software

creative computing software

Sports Games-1, CS-4002 (16K)

1. Baseball

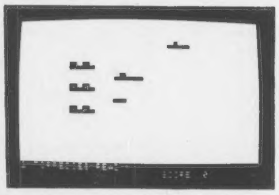
Play in the APPLE World Series! This two-player game is played according to Major League rules. Game paddles control the infielders and outfielders, as you pitch changeups, fastballs, sliders, curves or knuckleballs. When you're at bat, good timing is the key as you swing the bat with a



tap on the space bar. This exciting graphics game even includes stealing, double plays, and sacrifices under computer control.

2. Torpedo Alley

The object of Torpedo Alley is to sink as many ships as possible with your forward torpedo tubes. Move into position and FIRE!! But don't waste a shot—it takes time to reload when the tubes are empty. Targets include aircraft



carriers, patrol boats, destroyers, and cargo ships. Depending on your score, you earn the rank of cook, seaman, or captain. How many stripes for you?

3. Slalom

Have fun skiing without getting cold! Slalom is a downhill exercise in which you weave in and out of the flags on a championship slalom course. Game paddles control the speed and motion of the skier as you go for Olympic gold. But don't knock down any flags or go off the mountain. Swiss hospitals don't take Master Charge!

4. Darts

How's your aim? Play darts and find out. You have six darts to throw at a dartboard. The game paddles control the position of the darts. Can you hit the Bullseye?

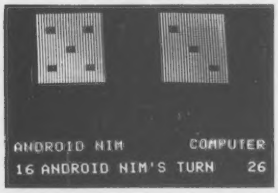
CIRCLE 205 ON READER SERVICE CARD

Strategy Games-1, CS-4003 (16K)

1. Checkers

(Requires Applesoft or Applesoft II BASIC)

This is the APPLE version of the popular board game, with color graphics. Test your strategy against the computer. The computer does not look ahead for future moves, hence it is best suited for beginning players.



2. Skunk

Skunk is a two player dice game in which the object is to accumulate 100 points before your opponent. On each turn you may roll the dice or "pass." You roll the dice by turning a game paddle, and the value of the roll is added to your total score. If you roll a 1, you lose all the points accumulated on that turn. If you roll snake eyes (two 1's), your total score goes to 0.

3. UFO

You are the captain of a space ship carrying the last remnants of the human race, after a space war with another planet in which both worlds were destroyed. The aliens have launched a similar vessel and will attempt to

destroy your ship. On each move you decide whether to maneuver, halt for repairs, or fire from your arsenal of heavy guns, warheads and lasers.

4. Blockade

In this game, each player controls a colored marker which leaves a trailing path. The object is to keep your marker in motion longer than your opponent by not running into a wall, the other player's path, or crossing your own path. Direction is controlled on the keyboard, but you can't stop moving. Game options include one or two player games, and accelerated speeds which increase as the game progresses.

5. Genius

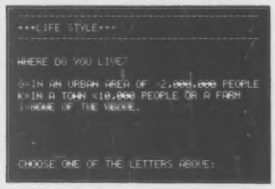
In each round of this game, you are given a potpouri of 5 trivia questions to answer as quickly as possible. Any final score above 400 will merit a rating of genius, but watch out! There's a 25 point penalty for each wrong answer. The quiz includes questions about movies, sports, TV, literature, general knowledge, and of course, computers.

Know Yourself, CS-4301 (16K)

The programs in this series aren't games, but they are fun to use. All of them are based on statistically valid tests and data. Using them from time to time could help you see in what direction your life is progressing.

1. Life Expectancy

Do you ever wonder how long you will live? Take the Life Expectancy quiz and find out! Will a different life style increase



your life expectancy? Will following all the advice in the National Enquirer really help?

2. Psychotherapy

The APPLE analyst asks you 20 questions to help you decide if you might benefit from a psychotherapist. Psychotherapy asks you about your feelings, actions, and phobias and compares them against population norms. Here's where you can talk freely about those special powers people are using against you. With sound. For all computer freaks.

3. Computer Literacy

Are you a computer whiz? Try this quiz and find out how much you know about computers and computing. On each round, answer 5 questions as quickly as possible. Depending on your score, you will be rated from janitor to a systems analyst. Questions range from history to present technology and applications. A large number of questions ensures variety on each round.

4. Alcohol

Are you a lush? Do you like to hide your Ripple in a Grape Nehi bottle? Alcohol allows you to experiment with the relationship between drinking, the alcohol level in your blood, and its effects on your behavior. Enter parameters such as body weight, time spent drinking,

type of beverage and number of drinks. Sound and graphics—even a bubbling champagne glass!—make Alcohol fun as well as informative.

5. Sex Role

Are you androgynous? This program helps you to examine your nature, behavior and attitudes in light of society's changing concept of sex roles.

CAI Programs, CS-4201 (16K)

1. U.S. Map

Do you have problems remembering which state is which? Do you know the capitals? After a few games of U.S. Map, you should have no trouble. This advanced application of APPLE high resolution graphics enhances interest in the learning process. Options allow you to choose whether to identify only the state or both the state and its capital. As the run progresses, missed states or capitals are repeated several times.

2. Spelling

(Requires Applesoft or Applesoft II BASIC)

Do you need practice spelling? Let APPLE's Spelling program lend a hand. You are shown a word and asked to spell it when it disappears. Grades from A+ to F are given depending on how many you get correct. The better you are, the shorter the time you see the hint word.

3. Math Drill

How are your math skills? Let Math Drill help you improve them. You can choose the type of problem you wish to practice—addition, subtraction, multiplication, division or mixed. You may also choose large or small numbers, whether or not to have a time limit, and how long the limit is to be.

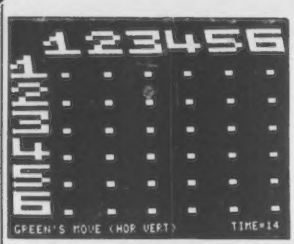
4. Add With Carry

Here is a program to help you with harder addition. You are presented with a series of addition problems of increasing difficulty. You add one column at a time, filling in the column sum and then the carry amount. If you do well, the problems get harder, if you don't, they get a little easier.

CIRCLE 205 ON READER SERVICE CARD

APPLE II

Brain Games-1, CS-4004 (16K)



1. Nuclear Reaction

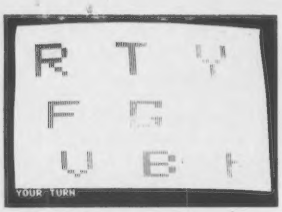
Nuclear Reaction is an exciting strategy game for two players. Each player, in turn, places a particle of radioactive material on a 6x6 board. When the number of particles at a location reaches its critical mass, it explodes, sending a particle to adjacent squares. As the board fills up, a single explosion can cause long chain reactions. The object of the game is to cause the right chain reaction to wipe out all your opponent's pieces. Nuclear Reaction is a game of skill, fast decisions, and quick reversals, making it fun to play for many hours. Action sound effects.

2. Dodgem

In Dodgem, two sets of pieces move at right angles across a checker style board. The object is to move all your pieces across the board and off the opposite edge. One player moves from the bottom to the top while the other moves left to right. You may play Dodgem against the APPLE or a friend. Six board sizes and action sound effects.

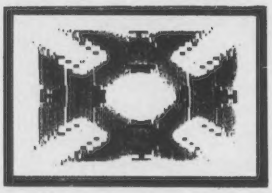
3. Dueling Digits

Do you have a good memory for sequences of numbers? Play Dueling Digits and find out. In this game, the computer presents a digit and tone, then erases it. You then type in the same digit. After each turn, the computer repeats all the previous digits and adds a new one, and you try to type in the entire sequence. The round is over when you make four mistakes. For up to four players. Two skill levels.



4. Parrot

Parrot is similar to Dueling Digits, but you try to remember sequences of letters and tones instead. Two skill levels.



5. Midpoints and Lines

These two colorful graphics demonstrations will run continuously. Great for store displays, parties, and showing off your computer.

6. Tones

This program allows you to make your own music and sound effects with the game paddles. One paddle controls the pitch of the tone, the other controls the duration. No special hardware is required.

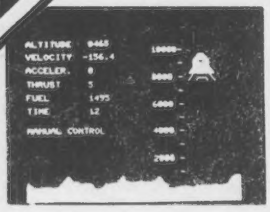
SORCERER

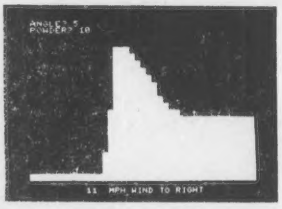
Smart Alec, CS-5002 (8K)

Smart Alec is fun as well as educational. Test your memory by answering five multiple-choice questions on each round. Each question has a time limit and you are penalized 25 points for a wrong answer. Your score is based on how long it takes you to get the correct answer. If you do well, the computer will certify you as a genius.

There are seven areas in which to test your expertise. They are:
1. Science
2. Geography
3. History
4. Computers
5. T.V. and Movies
6. English
7. Trivia

Graphics Games-2, CS-5001 (8K)





1. LEM

In this graphic version of the popular real time lunar landing game you must land on the moon's surface with the lowest possible velocity. You can control the thrust of your retro-rockets with the number keys but you have a limited amount of fuel. The automatic pilot option can be activated and deactivated with the keyboard. You take a walk on the moon and plant a flag if you land successfully.

2. Pie Lob

This is a game in which two players lob pies at each other across a computer-generated hill. You choose the angle and the strength of the throw and then watch the trajectory of the lob across the screen. The computer changes the terrain and the wind speed in each game. Pie Lob makes good use of SORCERER's graphics.

3. Nuclear Reaction

Nuclear Reaction is an exciting strategy games for two players. Each player, in turn, places a particle of radioactive material on a 6x6 board. When the number of particles at a location reaches its critical mass, it explodes, sending particles to adjacent squares. As the board fills up, a single explosion can cause long chain reactions. The object of the game is to cause the right chain reactions to wipe out all your opponent's pieces. Nuclear Reaction is a game of skill, fast decisions, and quick reversals, making it fun to play for many hours.

4. Bounce

Bounce is an intriguing graphics demonstration which traces the path of a ball as it bounces around the screen.

5. Checkers

The SORCERER matches its strategy against yours in this popular game. The computer does not look more than one move ahead, hence the game is best suited for beginning players.

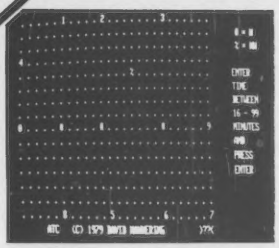
6. Dodgem

Dodgem is played on a checker-type board against the computer or another player. The object of the game is to block your opponent to slow him down. One player moves pieces from the bottom of the board to the top, and the other player moves from left to right, trying to get all the pieces off the board. This is a challenging game of strategy.

CIRCLE 205 ON READER SERVICE CARD

TRS-80 LEVEL II

Air Traffic Controller, CS-3006 (16K)

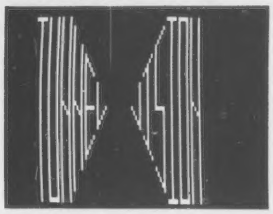


This real time machine language program puts you in the chair of an air traffic controller. There are 27 airplanes—jets and prop planes—which must be controlled as they land, take off and fly over your air space. You give the orders to change altitude, turn, maintain a holding pattern, clear for approach, and land at your two airports. This realistic simulation includes navigational beacons, and requires planes to take off and land into the wind. Air Traffic Controller was written by an air traffic controller and is a favorite of the Creative Computing staff!

Strategy Games, CS-3005 (16K)

1. Tunnel Vision

Tunnel Vision gives an exciting visual twist to the popular maze game. You are transported into a massive labyrinth and must find the exit or be lost forever. A mouse's eye view is displayed as you wander through the maze, seeing walls, turn-offs, and dead ends as they are encountered. This is an excellent example of three dimensional perspective using TRS-80 graphics.



2. Evasion

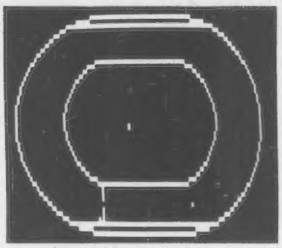
In this real time game, you are pursued around the game board by an evil-looking snake. The arrow keys control your small drone as it tries to avoid being bitten for as long as possible. (Evil-looking snakes always catch their drones.) Variations of play include two different speeds and hyper-jumps which randomly relocate you on the board. Looking for an escape? Try Evasion.

3. Jigsaw

Jigsaw is a computer-age puzzle game making extensive use of TRS-80 graphics. The computer generates a random puzzle and puzzle board. Using a combination of deductive reasoning and luck you must fit the graphically represented puzzle piece into place. Jigsaw has four different options featuring concealed pieces and helpful clues.

4. The Masters

Are you a wandering pro or just a Sunday golfer who would like to keep in practice? Each hole is graphically depicted from tee to green. You choose a club for your next stroke—wood, iron, or sand wedge. Once you're on the green, a worm's-eye view is displayed for putting.



5. Motor Racing

Motor Racing combines real time racing action with advanced graphics functions. You racing car may be driven on two skill levels. The first allows only for directional control on a simple track, while the second skill level offers a choice of professional tracks, the Indianapolis Speed Way or a road race course. The graphics and animation make Motor Racing fun to watch as well as play.

Board Games-1, CS-3001 (16K)

1. Mugwump

Mugwump is a board games which uses a 10x10 grid on which four friendly Mugwumps are hiding. Your mission is to locate these mysterious animals and capture them. You input X and Y coordinates for each move and after each round the distances from each mugwump are displayed. What is a mugwump? No one really seems to know, but if you find one, maybe you'll let us in on the secret.

2. Flip Disc

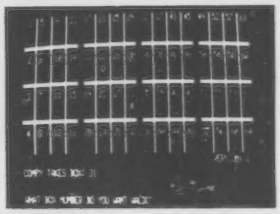
Are you an Othello freak? Do you wish there were someone who would provide you with a challenging game at a moment's notice? Flip Disc is a program which will turn your computer into an excellent opponent. Flip Disc provides the game board, chips, and handles all playing functions. Three different skill levels, (good, expert, and genius), provide an introduction for the novice and continuing interest for the experienced player.

3. Wumpus

Chances are if you ever leave your keyboard you have heard of the mythological Wumpus. In the game of Wumpus 1, you are scouring a network of underground caves in search of the prized Wumpus. The dreaded super bats and bottomless pits make Wumpus hunting a risky affair. On each turn, as you wind your way through the caves, you have a choice of moving or shooting through the cave. Bagging a Wumpus wins the game, but if you accidentally stumble into his cave, the Wumpus will enjoy a tasty dinner of sauteed computer freak.

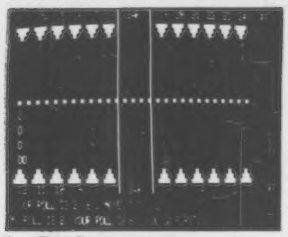
4. Wumpus 2

If you master the dodecahedron cave network in Wumpus 1, you may proceed to Wumpus 2 which allows you to choose from five different caves, or you can design your own. Super bats and the infamous bottomless pits are also included in Wumpus 2, so be prepared to jump into the frying pan!



5. Qubic

Qubic is a three dimensional Tic Tac Toe game. The game is played in a 3 dimensional cube (4x4x4). The object is to outwit the computer and place four pieces in any straight line. Be warned, the computer plays a very tough game and makes no concessions for your ability, or lack of it.



6. Backgammon

This is the TRS-80 adaptation of the popular board game. Backgammon uses graphics and all the standard backgammon rules, not a strange computer variation. The computer is your opponent in this version, written by Scott Adams of "Adventure" fame.

How To Order

Creative Computing Software should be stocked by your local retail computer store. If your favorite retailer does not have the software you need, have him call our retail marketing dept. at 800-631-8112. (In NJ, 201-540-0445).

Or you can order directly from Creative Computing. Use the handy order form on page 133.

sensational software

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CIRCLE 205 ON READER SERVICE CARD

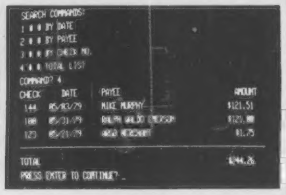
TRS-80 LEVEL II

Investment Analysis, CS-3305 (4K)

This program was originally developed for personal use by an investment specialist. Creative Computing Software now makes this package available for you to analyze your investments and investment decisions. Programs in this package include regression analysis, stock market simulations, market/stock values, risk analysis, time related investments, and tax analysis. (Available in October)

Checking Account, CS-3304 (16K)

This program does not replace the standard method of checkbook balancing. Instead it acts as an aid in keeping track


SEARCH COMMANDS:
1 # # BY DATE
2 # # BY PAYEE
3 # # BY CHECK NO.
4 # # TOTAL LIST
COMMAND? 4
CHECK# DATE PAYEE AMOUNT
144 05/03/79 MIKE MURPHY $121.51
TOTAL $744.26
PRESS ENTER TO CONTINUE?

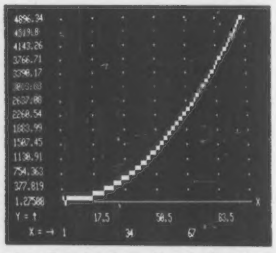
of individual and monthly expenses. You enter the amounts and payees of individual checks, and save the information on cassette tape. The program then allows you to analyze your checks by payee or date of payment. Keep track of where your money is going and how effective your budget is.

Graphic Package, CS-3301 (16K)

This package provides a variety of interesting and useful graphing routines. Graphing Package combines text and TRS-80 graphics to plot a variety of functions and other graphs.

1. Bar Graph

Bar Graph plots graphs for up to six different categories. An optional display does conversion to a line graph.

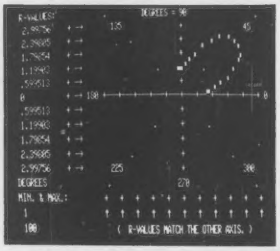


2. Cartesian Coordinate Graphing

This program plots a standard X, Y graph from a user entered function. A special feature of this program automatically scales of the Y-axis.

3. Polar Coordinate Graphing

Rarely found in computer graphing packages, this polar



graphing program provides plots of polar functions. The program labels all axes, features automatic scaling, and lets you input the range and increment of the plot. A unique and valuable program.

4. Parametric Graphing

Parametric functions are functions in which both x and y are expressed in terms of an independent variable t. The resulting graph is X vs. Y. This program allows the user to input two parametric functions and produces a graph.

5. Linear and Parabolic Regression

These two programs are used for data analysis which can later be entered into the graphing routines. Regression routines analyze how well a series of points fit on a linear or quadratic function.

Tape Manager and Advanced Statistics, CS-3303 (16K)

This package may be the ultimate in statistical applications for the 16K TRS-80. Attractively packaged in a vinyl binder with a large instruction booklet, Advanced Statistics will provide you with the ability to perform statistical tests never before available on small computers. Its cassette based data file system allows you to store, retrieve, and transform data files for use in several different tests.

1. Tape Manager

Tape Manager, the heart of the statistical file management, allows you to create, edit, and transform data files. Unique to this program are features that allow the user to perform transformations on variables, extract and create subfiles, and selectively copy records. Up to twenty variables and an unlimited number of cases can be processed.

2. Descriptive Statistics

Descriptive Statistics computes the mean, standard deviation, standard error of estimate, variance, skewness, kurtosis, range, median, and quartiles for a variable and constructs a histogram for each value. A test scoring option for conversion of raw scores into percentiles is included.

3. Two Variable Statistics

This program calculates descriptive statistics for each variable. It performs a t-test for the difference of means, computing. the product-moment correlation coefficient and its associated significance level. In addition, it performs linear regression and computes standard error of estimate for Y.

4. Crosstabulation

This program constructs contingency tables for displaying frequencies, column percentages and table-wide percentages for each cell. It computes the Chi-square, the level of significance and gamma statistics. Tables as large as 10x10 may be evaluated.

5. Regression-Trend Analysis

This program computes least-squares regression coefficients from time-series or paired data for best-fit equations (linear, parabolic, hyperbolic, logarithmic, power, exponential and cubic types). Calculates standard error of estimate for each equation and more.

6. Multiple Linear Regression

Performs multiple linear regression using up to ten independent variables. The program computes both unstandardized and normalized coefficients, covariance, multiple correlation coefficient, and the standard error of estimate.

7. Correlation Analysis

Computes product-moment correlation matrices, multiple correlation coefficients and partial correlation coefficients with their associated significance levels.

8. Analysis of Variance

This program performs one-way and two-way analysis of variance for a maximum of ten groups in each control variable. Statistics include the mean and standard deviation for each group, sum of the squares, degrees of freedom, mean square, F-ratios, and significance level.

Economic and Ecology Simulations

The Ecology Simulations series are a unique educational tool. They are based on "simulation models" developed by the Huntington Two Computer Project at the State University of New York at Stony Brook under the direction of Dr. Ludwig Braun. The programs and accompanying documentation are written for self-teaching or classroom use and include background material, sample exercises and study guides. Graphic displays were specially developed by Jo Ann Comito at SUNY and Ann Corrigan at Creative Computing. The Ecology Simulations packages are a remarkable educational application of micro-computers.

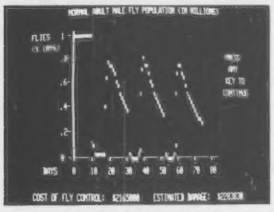
Ecology Simulations-1, CS-3201 (16K)

1. Pop

The POP series of models examines three different methods of population projection, including exponential, S-shaped or logistical, and logistical with low density effects. At the same time the programs introduce the concept of successive refinement of a model, since each POP model adds more details than the previous one.

2. Steri

STERL allows you to investigate the effectiveness of two different methods of pest control—the use of pesticides and the release of sterile males into the fly population. The concept of a more environmentally sound approach versus traditional chemical methods is introduced. In addition, STERL demonstrates the effectiveness of an integrated approach over either alternative by itself.



3. Tag

TAG simulates the tagging and recovery method that is used by scientists to estimate animal populations. You attempt to estimate the bass population in a warm-water, bass-bluegill farm pond. Tagged fish are released in the pond and samples are recovered at timed intervals. By presenting a detailed simulation of real sampling by "tagging and recovery," TAG helps you to understand this process.

4. Buffalo

BUFFALO simulates the yearly cycle of buffalo population growth and decline, and allows you to investigate the effects of different herd management policies. Simulations such as BUFFALO allow you to explore "What if" questions and experiment with approaches that might be disastrous in real life.

IQ Test, CS-3203 (16K)

IQ tests have been the subject of a great deal of controversy in the past few years. Yet, few of us know our IQ score. Now you can find out with our IQ test.

Taking advantage of the TRS-80's graphic capabilities, this test consists of 60 multiple choice questions. A special machine language routine does the scoring of the test and makes cheating almost impossible.

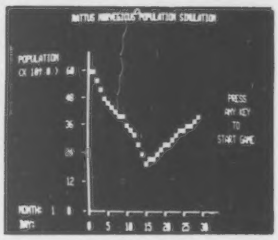
Ecology Simulations-2, CS-3202 (16K)

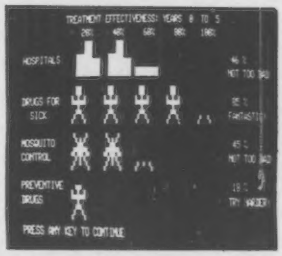
1. Pollute

POLLUTE focuses on one part of the water pollution problem; the accumulation of certain waste materials in waterways and their effect on dissolved oxygen levels in the water. You can use the computer to investigate the effects of different variables such as the body of water, temperature, and the rate of dumping waste material. Various types of primary and secondary waste treatment, as well as the impact of scientific and economic decisions can be examined.

2. Rats

In RATS, you play the role of a Health Department official devising an effective, practical plant to control rats. The plan may combine the use of sanitation and slow kill and quick kill poisons to eliminate a rat population. It is also possible to change the initial population size, growth rate, and whether the simulation will take place in an apartment building or an entire city.





3. Malaria

With MALARIA, you are a Health Official trying to control a malaria epidemic while taking into account financial considerations in setting up a program. The budgeted use of field hospitals, drugs for the ill, three types of pesticides, and preventative medication, must be properly combined for an effective control program.

4. Diet

DIET is designed to explore the effect of four basic substances, protein, lipids, calories and carbohydrates, on your diet. You enter a list of the types and amounts of food eaten in a typical day, as well as your age, weight, sex, health and a physical activity factor. DIET is particularly valuable in indicating how a diet can be changed to raise or lower body weights and provide proper nutrition.

Social and Economic Simulations CS-3204 (16K)

1. Limits

LIMITS is a micro-computer version of the well known "Limits to Growth" project done at MIT. It contains a model of the world that is built of five subsystems (population, pollution, food supply, industrial output, and resource usage) linked together by six variables: birth rate, death rate, pollution generation, resource usage rate, industrial output growth rate, and food production rate.

2. Market

Market allows two or more people to play the roles of companies who are competing for the market for a particular product: in this case, bicycles.

Each player makes marketing decisions quarterly including the production level, the advertising budget, and the unit price of the product for his/her company.

3. USPop

USPOP allows the user to study many aspects of the United States' human demography (population change) including population growth, age and sex distribution. USPOP makes population projections and investigates the consequences of many different demographic changes.

(Available in November).

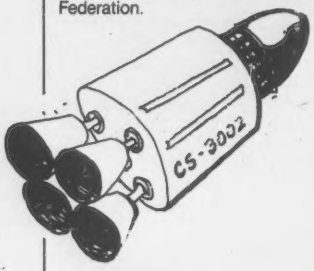
CIRCLE 205 ON READER SERVICE CARD

TRS-80 LEVEL II

Space Games-3, CS-3002 (16K)

1. Ultra-Trek

Ultra-Trek is a fast-paced version of Star Trek, complete with "real time" action graphics, lasers, Nilon space mines, high energy photon torpedoes, enemy ships that move, and an experimental ray which does something different each time you use it. At the beginning of your mission, you are told the number of Klingon base ships and battle cruisers you must defeat. Klingons have sharp eyes and quick torpedo launchers. They don't wait for you to type in your moves, so you must act quickly to save yourself and the Federation.



2. Romulan

Your mission is to destroy an invading Romulan space craft, but you'll have to find it first. The Romulans have a new cloaking device. By activating your sensors, the Romulan's position will be shown briefly, but the sensors use a lot of energy. Maneuver through space and around stars looking for the deadly enemy, but be careful! The nasty Romulans fire back.

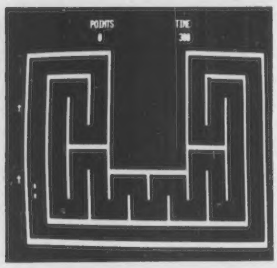
3. Star Wars

If you hate Darth Vader, you'll love Star Wars. Take an X-Wing fighter into combat and save the Rebels' base camp. Using the keyboard to control the ship, you must line up the TIE fighters into your sights and zap them with your lasers. This real time game is fun for aliens of all ages. May the Force be with you!

4. Star Lanes

Imagine yourself the president of an intergalactic shipping company. In Star Lanes you control sections of the galaxy and, on each turn, are given chances to buy stock in developing businesses. You are free to roam about the galaxy and engage in bartering, business ventures, stock splits, and company takeovers. If you're successful, you may be named Imperial Advisor on Economic Affairs. Entrepreneurs: to your ships.

Pursuit Games, CS-3004 (16K)



1. Stock Car Race

Stock Car Race is a real time racing game on a road race circuit. Your high speed racer is controlled by the "arrow" keys, as you shift up and down through four gears. Take the turns slowly, "floor it" on the straights, but don't blow your engine!

2. Maze

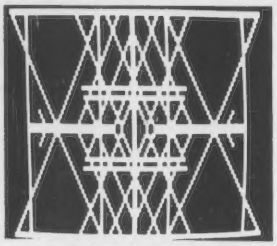
Maze for the Level II 16K machine is a high speed pursuit game. You are timed throughout your run and rated on the basis of elapsed time and the number of moves required to escape. A different maze every time. Nine skill levels.

3. Indy Racer

Indy Racer is a real time racing game for the TRS-80. You're in the driver's seat of a red-hot Indy car, changing gears and weaving around the track as you pass your competitors. Indy Racer is similar to the popular arcade-style driving games.

4. Depth Charge

As commander of a destroyer, your mission is to destroy as many enemy subs as possible. Move your ship back and forth on the water, positioning yourself over enemy subs as they cruise into range. Depth charges sink slowly, so timing and position are important in this re-creation of the Battle of the Atlantic.

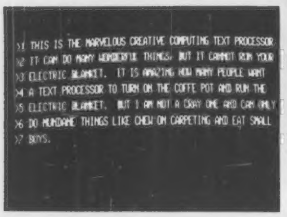


5. Kaleidoscope

This graphics demonstration program turns your TRS-80 into a computer age kaleidoscope. You enter the number of lines and size of the display to produce changing patterns on the video monitor. Truly hypnotizing, Kaleidoscope runs continuously to brighten up your home or office.

Text Processing, CS-3302 (16K)

This program turns a 16K, TRS-80 and lineprinter into a line oriented text-processing system.


1(THIS IS THE MARVELOUS CREATIVE COMPUTING TEXT PROCESSOR
2(IT CAN DO MANY WONDERFUL THINGS, BUT IT CANNOT RUN YOUR
3(ELECTRIC BLANKET. IT IS AMAZING HOW MANY PEOPLE WANT
4(A TEXT PROCESSOR TO TURN ON THE COFFEE POT AND RUN THE
5(ELECTRIC BLANKET. BUT I AM NOT A CRAY ONE AND CAN ONLY
6(DO MUNDANE THINGS LIKE CHEW ON CARPETING AND EAT SMALL
7(BOYS.

Developed exclusively for the TRS-80, this program lets you use the computer to enter general text or business letters, edit and modify your work, save text on cassette tapes, and print out a perfect report, document, or letter every time.

Editing commands are similar to those used in Level II BASIC, so there are no complicated new commands to learn. Lines may be either inserted or deleted. A special format is available to speed entry of business letters. Final printout can be done in numbered pages and you may print multiple copies.

TRS-80 Software on Disks, (32K)

Now, Creative Computing offers its cassette software on floppy disks. These are not just the same programs simply stored on a disk, but enhanced, menu driven libraries for the ultimate in ease of use. Machine language routines have been relocated to be compatible with disk basic, and the file handling, such as is used in the Checking Account program, can now be handled using your TRS-80 mini-floppy system. Make the most of your TRS-80 with Creative Computing floppy disk software.

CS-3501 ECOLOGY SIMULATIONS-1
Pop — Tag
Sterl — Buffalo

CS-3502 ECOLOGY SIMULATIONS-2
Pollute — Malaria
Rats — Diet

CS-3507 SOCIAL & ECONOMIC SIMULATIONS
Limits — USPop
Market

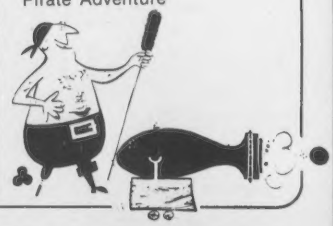
CS-3503 GAMES PACK-1

Backgammon	Stock Car Race
Qubic	Maze
Flip Disc	Indy Racer
Wumpus 1	Depth Charge
Wumpus 2	Kaleidoscope
Mugwump	Tunnel Vision
Ultra Trek	Evasion
Romulan	Jigsaw
Star Wars	The Masters
Star Lanes	Motor Racing

CS-3504 TEXT PROCESSING CHECKING ACCOUNT

CS-3505 ADVANCED STATISTICS
Data File Manager
Descriptive Statistics
Two Variable Statistics
Crosstabulation
Regression
Multiple Linear Regression
Correlation Analysis
Analysis of Variance
Advanced Multiple Regression

CS-3506 ADVENTURE 1 AND 2
Adventure
Pirate Adventure



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LOGIC GAMES-2 (8K)(CS-1003) Challenge your logic ability in 6 more games.
GRAPHICS GAMES-1 (8K)(CS-1004) Five action-packed graphics contests.
GRAPHICS GAMES-2 (8K)(CS-1005) Nuclear reactions, lunar landings, and 3 more.
NUMBER GAMES-2 (8K)(CS-1002) Six number-guessing games.
CONVERSATIONAL GAMES-2 (8K)(CS-1006) Test your wit in 6 unusual games.
BOARD GAMES(8K)(CS-1007) Yahtzee, Backgammon, Blackjack, Trek-3, and more.
ACTION GAMES (8K) (CS-1008) Battle it out with torpedos, depth charges and road racers.
ADVENTURELAND AND PIRATE ADVENTURE (24K)(CS-1009) see 3007 and 8 for the TRS-80.
SENSATIONAL SIMULATIONS (8K)(CS-1201) Ancient Sumeria, the stock market and more.
STUDY MADE EASY (8K)(CS-1202) Create study drills for any subject automatically.

TRS-80 LEVEL I GAMES-1 (4K)(CS-2001) Five games, including Battling Death Stars.
GAMES-2 (4K)(CS-2002) Forecast your biorythms, compose music, and 3 more.
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TAPE MANAGER/GRAPHICS/STATISTICS (4K)(CS-2301) Statistical computations and displays.
INVESTMENT ANALYSIS (4K)(CS-3305) Analyse your investment decisions.

TRS-80 LEVEL II BOARD GAMES-1 (16K)(CS-3001) Othello, backgammon and 4 more.
SPACE GAMES-3 (16K)(CS-3002) Star Wars, Romulan, Ultra Trek, Star Lanes.
PURSUIT GAMES (16K)(CS-3004) Stock Car Race, Maze, Indy Racer, and 2 more.
STRATEGY GAMES (16K) (CS-3005) Tunnel Vision, Evasion, Jigsaw, and 2 more.
AIR TRAFFIC CONTROLLER (16K)(CS-3006) Control 27 planes in your airspace.
ADVENTURELAND (16K)(CS-3007) An enchanted world of magical beings, puzzles, and perils.
PIRATE ADVENTURE (16K)(CS-3008) You'll meet the Pirate on your say to Treasure Island.
MISSION IMPOSSIBLE ADVENTURE (16K)(CS-3009) Save the world's 1st nuclear reactor.
VOODOO CASTLE (16K)(CS-3010) Rescue Count Cristo from the fiendish curse.
THE COUNT (16K)(CS-3011) You wake up in a brass bed in Transylvania Castle...
ECOLOGY SIMULATIONS-1 (16K)(CS-3201) Investigate population projection.
ECOLOGY SIMULATIONS-2 (16K)(CS-3202) Control epidemics, pests, and pollution.
IQ TEST (16K)(CS-3203) A genuine IQ test, impossible to cheat.
SOCIAL AND ECONOMIC SIMULATIONS (16K)(3204) "Limits to Growth" and much more.
GRAPHIC PACKAGE (16K)(CS-3301) Sophisticated Graphing routines and other computations.
ADVANCED STATISTICS(16K)(CS-3303) Variance and correlation analysis, cross-tabulation, multiple linear regression, and descriptive statistics.
CHECKING ACCOUNT (16K)(CS-3304) Organize your checking account.
INVESTMENT ANALYSIS (4K)(CS-3305) Analyse your investment decisions.

TRS-80 DISKS ECOLOGY SIMULATIONS-1 (32K)(CS-3501) for the TRS-80, see CS-3201.
ECOLOGY SIMULATIONS-2 (32K)(CS-3502) see CS-3202 for the TRS-80
GAMES PACK-1 (32K)(CS-3503) Space, pursuit, strategy, and board games.
TEXT/PROCESSING/CHECKING ACCOUNT (32K)(CS-3504) see CS3302 and CS-3304 for the TRS-80.
ADVANCED STATISTICS (32K)(CS-3505) see CS-3303 for the TRS-80.
ADVENTURELAND AND PIRATE ADVENTURE (32K)(CS-3506) see CS-3007 and CS-3008.
MISSION IMPOSSIBLE AND VOODOO CASTLE ADVENTURE (32K) (CS-3507) see CS-3009 and CS-3010 for the TRS-80.
SOCIAL AND ECONOMIC SIMULATIONS (32K)(CS-3508) see CS-3204 for the TRS-80.

APPLE II SPACE GAMES (16K)(CS-4001) Four challenging galactic games.
SPORTS GAMES(16K)(CS-4002) Baseball, Torpedo Alley, Slalom, and Darts.
STRATEGY GAMES-1 (16K)(CS-4003) Blockade, Skunk, UFO, and Checkers.
BRAIN GAMES-1 (16K)(CS-4004) Six exciting programs with sound effects.
HAUNTED HOUSE (16K)(CS-4005) Search for a secret passageway. With sound effects.
CAI PROGRAMS (16K)(CS-4201) Spelling, Geography, individualized Math programs.
KNOW YOURSELF (16K)(CS-4301) Your sex role, life expectancy, mental health and response to alcohol.
SPACE INVADER (32K)(CS-4006) The arcade style invader game. 55 aliens, high resolution graphics, and sound effects.

APPLE II DISK SPACE AND SPORTS GAMES (32K)(CS-4501) see CS-4001 and 2 for the Apple.
STRATEGY AND BRAIN GAMES (32K)(CS-4502) see CS-4003 and 4 for the Apple.
CAI PROGRAMS/KNOW YOURSELF (32K)(CS-4503) see CS-4201 and CS-4301 for the Apple.
SPACE INVADER (48K)(CS-4503A) The arcade style invader game. 55 aliens, high resolution graphics, and sound effects.

SORCERER GRAPHICS GAMES (8K)(CS-5001) Six action-packed graphics games.
SMART ALEC (8K)(CS-5002) Test your expertise in 7 categories, 200 questions.
ADVENTURELAND (16K)(CS-5003) see CS-3007 for the Apple.
PIRATE ADVENTURE (16K)(CS-5004) see CS-3008 for the Apple.
MISSION IMPOSSIBLE ADVENTURE (16K)(CS-5005) see CS-3009 for the Apple.
VOODOO CASTLE (16K) (CS-5006) see CS-3010 for the Apple.
THE COUNT (16K)(CS-5007) see CS-3011 for the Apple.

CHALLENGER GRAPHICS GAMES-3 (8K)(CS-6001) 5 action packed graphics games.

SOL-20 AIR TRAFFIC CONTROLLER (16K)(CS-8001) see CS-3006 for the Apple.
SPACE GAMES-4 (32K)(CS-8003) Star Wars, Lunar Lander, Asteroid, and Romulan.
STRATEGY GAMES (32K)(CS-8004) Five fun and challenging brain games.
READING COMPREHENSION (20K)(CS-8201) Short stories and comprehension questions, with a 32 page instruction manual.

CP/M INVESTMENT ANALYSIS (4K)(CS-9003) see CS-3305 for the TRS-80.
BASIC GAMES-1 (48K)(CS-9001) 51 of our best action and strategy games.
BASIC GAMES-2 (48K)(CS-9002) 51 more fun and challenging games.
BASIC GAMES 1AND 2 AND BASIC COMPUTER GAMES BOOK (48K) (CS-9000)
BASIC GAMES-3 (48K)(CS-9005) 50 programs for games freaks.
BASIC GAMES-4 (48K)(CS-9006) Hours of diversion with 38 games.
BASIC GAMES 3 AND 4 AND MORE BASIC COMPUTER GAMES BOOK (48K)(CS-9007)
BASIC GAMES 1 THROUGH 4, BASIC COMPUTER GAMES AND MORE BASIC COMPUTER GAMES BOOKS (48K)(CS-9008)
ORIGINAL ADVENTURE (48K)(CS-9004) Underground caverns of treasures and perils bi-lingual English and French.

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	3203	$14.95	
	3204	$24.95	
	3301	$7.95	
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	3505	$24.95	
	3506	$24.95	
	3507	$24.95	
	3508	$24.95	

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	5005	$14.95	
	5006	$14.95	
	5007	$14.95	
	CHALLENGER 1P		
	6001	$7.95	
	SOL-20		
	8001	$7.95	
	8003	$7.95	
	8004	$7.95	
	8201	$50.00	
	CP/M		
	9000	$50.00	
	9001	$24.95	
	9002	$24.95	
	9003	$24.95	
	9004	$24.95	
	9005	$24.95	
	9006	$24.95	
	9007	$50.00	
	9008	$95.00	
	BOOKS		
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	6B	$8.95	
	6C	$7.50	
	6C2	$7.50	
	6Z	$8.95	
	9Z	$4.95	
	10R	$3.95	
	Shipping and handling		$2.00
	NJ residents add 5% tax		
	TOTAL		

Apple-Cart

Chuck Carpenter

Correspondence is always welcome and a response will be made to those accompanied by a SASE. Send your letters to: Chuck Carpenter, 2228 Montclair Pl., Carrollton, TX 75006.

Protected Software

Gregory Yob, in a recent PET column (Creative Computing, Sept. '79), pointed out some software problems that are also appropriate for Apple owners. The particular problem has to do with protected software. That is, software designed to prevent you from making copies or changes, or that destroys itself if you make such an attempt. If software theft is a real problem then there is possibly some advantage to the seller. I say possibly because a good programmer can "fix" the software anyway. And, with special equipment, anything that is recorded on a magnetic surface can be copied onto a magnetic surface. For the most part, the attempts to prevent theft will only cause problems for the purchaser. If the software can't be copied for back-up then the user has to buy another when the original wears out. Stores selling software will be caught in the middle. If an attempt at goodwill, by replacing the software, results in loss of revenue, stores will stop buying. The whole thing would be likely to wind up in a vicious cycle — no one will buy the software so no one can sell . . .

Applesoft — Keyword Search

Searching files for keywords is a relatively easy task, especially if you are using the Apple DOS. The program segment in Listing #1 is part of a simple text file program. As you can see from the sample run in Listing #2, this is one of the file options. The parameters and variables needed for this segment to run were established at the beginning of the main program. To help with an understanding of how this routine functions, here is a list of the variables used:

D$ = CHR$(4) = control D
F$ = Name of active file
K$ = Keyword to search for
K = Keyword found flag
C = Record counter
I & J = Local loop variables
Q$ = local response to input prompts
CHR$(13) = return key

To make it easier to follow, the program was written with a simple format and very few multiple line statements. Assume that a file exists with the name Apple Demo and that all variables have been initialized. When keyword search is selected from the options list, the title is displayed by line 6035. In line 6040, an input request is made for the keyword. Having entered the keyword, lines 6050 through 6080 open the file and READ record zero to get the record count. The READ operation is stopped in line 6090 with a control D. In lines 6100 thru 6120 the first record (or Jth record) is read in from the file and the READ is then stopped by the control D in line 6130.

String parsing, for the keyword, is accomplished in lines 6140 through 6180. The string length, minus the length of the keyword, is set in line 6140. For unformatted text, setting the record length to 80 will be wasteful. However, this allows you to edit the record easier. And, use of structured formatted records will be the more likely application for this kind of file. Line 6150 checks a sub-string of characters equal in length to the keyword. If a match is found, the record number and the record are printed by line 6160. If no match is found, I is incremented and the next sub-string of characters is checked. This cycle is continued until all characters are checked or each occurrence of the keyword is found. If you don't want or need to find all occurrences of the keyword in a record, then add a GOTO 6190 command in line 6170.

Once the record search has been completed, J is incremented and the next record is read by line 6110. Now, the parsing process continues until all records in the file, equal to the value of C, have been read and parsed for the keyword. Lines 6200 through 6300 are a variety of options for working with the text file. If no keyword was found another one can be selected. Records containing the keyword can be edited, or simply choose to return to the file options. Note that in line 6290, GET A$ was used to accept keyboard input. Also, CHR$(13) was used to allow only the use of the return key to return to the options list. Pressing any other key will clear the screen and display the press return prompt. Try this parsing routine on your own programs. Also, rewrite it for primary and secondary keywords.

Integer BASIC — The MOD Function

One command only briefly described in the Red Book, and only casually mentioned in the Integer BASIC manual, is the MOD function. MOD is an abbreviated form of the word Modulo. It is described in the Red Book as: the remainder after the division of one expression by another expression. For example, in this statement, R=X MOD Y, R will equal the remainder when the value X is divided by the value Y. Because only integers are allowed otherwise, this is a useful way to find the remainder after a division is executed. The immediate execution mode will let you find the value by typing in PRINT (#1) MOD (#2) on your Apple and pressing return. There are several programs containing examples of the MOD function in the Red Book.

Another application for the MOD function is to POKE address data into

Apple-Cart, con't...

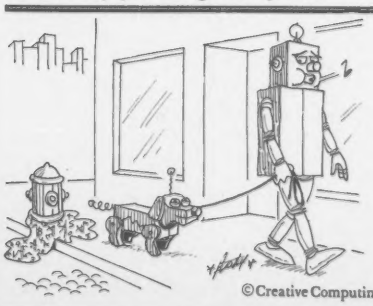
memory. Rather than calculating the data values of memory addresses yourself, the MOD function will help you do it. For instance, to move LOMEM you can POKE the decimal value into memory like this:

```
POKE 74, ADDR MOD 256
POLE 75, ADDR / 256
      LOMEM pointer

POKE 204, ADDR MOD 256
POKE 205, ADDR / 256
      Variables pointer
```

If you want to move LOMEM from $0800 to $0900 (the $ means a hexadecimal number), convert the address to its decimal value and include the result in place of ADDR. The HEX number $0900 is equal to 2304 decimal and will be POKEd into memory as 2304 MOD 256 = 00 and 2304 / 256 = 09. As you can see, these values equal the original HEX address: LO byte first, HI byte second. Try this with some addresses that are not as obvious; $1ABC for instance. Here's a short program to illustrate another use of the MOD function:

```
>LIST
 1000 REM  *** MOD DEMO ***
 1010 REM
 1020 PRINT
 1030 INPUT "NUMERATOR = ",N
 1040 INPUT "DENOMINATOR = ",D
 1050 PRINT N;" / ";D;"
      IS APPROXIMATELY"
 1060 PRINT N/D;".";
 1070 FOR I=1 TO 20
 1080 F=N MOD D
 1090 IF F>3276 THEN 1130
 1100 N=F*10
 1110 PRINT N/D;
 1120 NEXT I
 1130 PRINT
 1140 GOTO 1020

>RUN

NUMERATOR = ?30000

DENOMINATOR = ?111

30000 / 111 IS APPROXIMATELY
270.27027027027027027

NUMERATOR = ?
```

If you have an interesting idea or a question you haven't found an answer for, I'd enjoy hearing from you.



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```
6000 :
6010  REM  ** KEYWORD SEARCH **
6015  REM  ********************
6020 :
6030  HOME
6035  PRINT : PRINT "KEYWORD SEARCH - ";F$;""
6040  PRINT : INPUT "KEYWORD - ";K$
6050  LET K = 0
6060  PRINT D$"OPEN";F$;",L80"
6070  PRINT D$"READ";F$;",R";0
6080  INPUT C
6090  PRINT D$
6100  FOR J = 1 TO C
6110  PRINT D$"READ";F$;",R";J
6120  INPUT R$(J)
6130  PRINT D$
6140  FOR I = 1 TO 80 -  LEN (K$)
6150  IF  MID$ (R$(J),I, LEN (K$)) <  > K$ GOTO 6180
6160  PRINT : PRINT J;: PRINT " ";: PRINT R$(J)
6170  LET K = K + 1
6180  NEXT I
6190  NEXT J: PRINT
6200  IF K > 0 GOTO 6240
6210  PRINT : PRINT "NOTHING FOUND - ": PRINT "TRY ANOTHER KEY WO
      RD ? Y/N ";
6220  INPUT Q$: IF Q$ = "Y" GOTO 6000
6230  IF Q$ = "N" GOTO 6290
6240  PRINT D$"CLOSE";F$;""
6250  PRINT : PRINT "DO YOU WANT TO EDIT ? Y/N ";
6260  INPUT Q$: IF Q$ = "Y" GOTO 5000
6270  PRINT : PRINT "TRY ANOTHER KEYWORD ? Y/N ";
6280  INPUT Q$: IF Q$ = "Y" GOTO 6000
6290  PRINT : PRINT "PRESS RETURN TO CONTINUE - ";: GET A$: IF A$
      =  CHR$ (13) THEN  HOME : VTAB (5): GOTO 1090
6300  HOME : GOTO 6290
```

Listing 1

```
]RUN
BUILD AND APPEND A FILE
-----------------------
ENTER THE FILE NAME - APPLE DEMO

FILE OPTIONS:

1979 10/05 08:25:43.328

 1. BUILD NEW RECORDS
 2. ADD MORE RECORDS
 3. LIST RECORDS
 4. EDIT A RECORD
 5. KEYWORD SEARCH
 0. END THE PROGRAM

FILE'APPLE DEMO'CONTAINS 6 RECORDS !

WHICH NUMBER - 3

LIST TEXT FILE - APPLE DEMO

FAST OR SLOW ? F/S F
1   WELL WELL! WHAT SHALL WE PUT IN THIS FILE?
2   BECAUSE IT'S A DEMO OF THE KEYWORD SEARCHING
3   PROGRAM SEGMENT -- I'LL JUST PUT IN A FEW
4   LINES AND SHOW HOW TO SEARCH FOR A KEYWORD.
5   ACTUALLY -- I CAN PUT IN AS MANY RECORDS AS
6   THE DISK WILL HOLD. BUT -- I'LL END IT HERE.
PRESS RETURN TO CONTINUE -
.
.
WHICH NUMBER - 5

KEYWORD SEARCH - APPLE DEMO

KEYWORD - KEYWORD

2 BECAUSE IT'S A DEMO OF THE KEYWORD SEARCHING

4 LINES AND SHOW HOW TO SEARCH FOR A KEYWORD.
DO YOU WANT TO EDIT ? Y/N ?N

TRY ANOTHER KEYWORD ? Y/N ?Y

KEYWORD SEARCH - APPLE DEMO

KEYWORD - APPLE

NOTHING FOUND -
TRY ANOTHER KEY WORD ? Y/N ?N

PRESS RETURN TO CONTINUE -
```

Listing 2

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Apple Blooms

Now that the Apple computer has been available for over two years, things are a lot simpler. There was a time when the "Red Book" — "The Apple II Reference Manual" — was the primary source of information (it gets little use now I'd guess). For some, it was enough to get started in high style. For others, the information was confusing and didn't help much at all. But, many of the early Apple owners dug in and solved the mysteries of Apple's inner workings. Several Apple Users Groups were organized and soon started publishing Apple newsletters. And Apple Computer Company overcame production obstacles and provided us with manuals for everything our Apples can do. As a result, there is now a small library of manuals, books and newsletters available for you to use for your programming tasks. The following is a list of Apple books and manuals and some of the more noteworthy newsletters:

Apple II Reference Manual
: This is the "Red Book." Still the best source of documentation on Apples's inner workings. Not much help for the newcomer to programming.

Apple II BASIC Programming Manual
: The first of Apple's tutorial books. An in-depth study of integer BASIC. And a very refreshing style of presentation, especially for the newcomer.

The Applesoft Tutorial
: A book that gives Applesoft the same start-from-the-beginnig approach used in the integer BASIC manual. Assumes use of Autostart ROM.

Applesoft II BASIC Programming Reference Manual
: This book tells everything about Applesoft. Complete language implementation and usage of memory included. The appendix includes a large selection of data, too.

DOS Version 3.2 Disk Operating Instructional and Reference Manual
: Do's and Don'ts of DOS. Everything you need to work with the Apple DOS, including direct access to data written on tracks and sectors.

Apple Pascal Preliminary Reference Manual
: A thorough preliminary treatment of Apple Pascal for the experienced programmer.

Pascal Users Manual and Report, 2nd Edition.
: A publication by the people who developed this version of Pascal. Complete syntax and language description.

Microcomputer Problem Solving Using Pascal
: A textbook by Bowles. Used for an introductory course in Pascal programming. Most programs in the book will not run directly on the Apple, but a good starting place.

Utility and Accessory Manuals

Apple Language System Installation and Operating Manual
: How to install the Language System and get it running. Includes a chapter on features and use of the Autostart ROM.

Programmers Aid #1

Installation and Operators Manual
: Complete documentation of features and applications of the ROM resident programs. Worth having just for the documentation. Comes with the ROM.

Apple Software Bank Volumes 1-5
: The manual for volumes 1 and 2 gives brief descriptions of the programs and how to run them. Volumes 3-5 are given very extensive treatment. Much in-depth discussion of the programs is included (and there are some good ones too).

Communications Interface Card
: How to install it and use all the features it has. Designed for use with a Modem. Pascal supports this card with full capability.

Serial Interface Card
: More how-to-install-it and application instructions, but different from the Comm card. Not as versatile but very effective for driving a printer. Does not have hand-shaking so printers can't run at top speed.

Parallel Interface Card
: Tells how to hook it up and use it with the variety of parallel printers now on the market that will work with the Apple II.

Some Noteworthy Newsletters

Call A.P.P.L.E.
: 8710 Salty Drive N.W.
Olympia, WA 98502
(206) 866-1500
This is the good one. Be sure to get all the back issues.

Applesauce
: 12804 Magnolia
Chino, CA 91710
The fastest growing from the new "Original Apple Corps." Get the back issues, too.

ABACUS
: 2850 Jennifer Dr.
Castro Valley, CA 94546
May not have back issues — too bad.

NEWSLETTER for Apple II Owners
: Southeastern Software
7270 Culpepper Drive
New Orleans, LA 70126
Geared to the beginner. Back issues may be available.

Check with the newsletters at the address given for price and availability. These newsletters will provide a lot of help for the Apple owner; sometimes in new and unusual ways.

Apple Things

In addition to the many peripherals and peripheral driver boards provided by Apple, there are many more available from independent sources. Here are some that are known to perform as advertised.

Mountain Hardware Clock Board
: Keeps accurate time; useful for logging date and time on listing and in programs; measures elapsed time, time intervals and control interrupts on a real-time basis; has battery back-up; complete with all operating information. Mine has been keeping accurate time — even with power failures — for over 10 months. Price: $215.00 with complete instructions in a 40-page manual.

Mountain Hardware ROMPLUS+
: Includes six, 2K ROM sockets, one with a high resolution graphics monitor providing upper and lower case. Can be connected to keyboard shift key. Or, use a control character to shift for upper case. Works with all the Apple languages except the Language System (Pascal). ROM expansion is bank switched into the $C800 to $CFFE memory space. Price: $169.00 with 2 manuals and a demonstration diskette.

These two are available from computer stores and:

Mountain Hardware
300 Harvey West Blvd.
Santa Cruz, CA 95060

Serial Interface — RS232
: Switch Selectable baud rates. Includes ROM operating program, has full handshaking and works with Pascal. Price: $160.00 from:
California Computer Systems
309 Laurelwood Road
Santa Clara, CA 95060

CCS has a variety of Apple II interface boards. Information will be provided as soon as available.

Serial Interface - RS232
: Low cost but effective serial board. Requires a software program in memory. Includes programs to help tune the baud rate for your printer. Price $62.00 from:
Electronic Systems
P.O. Box 21638
San Jose, CA 95151

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Micro Modem

Couples your computer directly to the telephone. Uses an FCC approved coupler. Requires a modular jack or an adapter. Answers the phone for you. Or, you can set it up to dial phones for you under program control. You can manually dial phones right from the keyboard. Price: $365.00 from computer stores or from:

D. C. Hayes Associates, Inc.
16 Perimiter Park Drive
P.O. Box 9884
Atlanta, GA 30319

There are many other products being offered for the Apple. As soon as information is available, good or bad, I'll pass it along.

Software

There's a lot of it. I sat down with several magazines to see how many software sources I could find. There were so many that it became impractical to list them all, at least for this column. So how do you know the software is something you want and is worth the price? Through the mail, there is no other way than to take the risk. The better ones get reviewed and this helps. If you can get to a computer store and see a demonstration, your risk is minimized. If good results are obtained from the purchased software, spread the word. If the results leave a lot to be desired, this also needs to be known. If you get ripped-off, be sure and tell the people that can publish the details. Be sure you attempt to get corrective action yourself first. And politely document your efforts. There are a number of good software sources that will support their products. If enough people make their 10 to 25 dollar losses known, then the not-so-good ones will disappear. □

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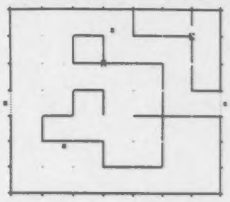
Software for the Apple II



SCORE: 108 SCORE: 105

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ULTRA BLOCKADE— the standard against which other versions have to be compared. Enjoy Blockade's superb combination of fast action (don't be the one who crashes) and strategy (the key is accessible open space—maximize yours while minimizing your opponent's). Play against another person or the computer. New high resolution graphics lets you see how you filled in an area—or use reversibility to review a game in slow motion (or at top speed, if that's your style). This is a game that you won't soon get bored with! By Don Stone. Integer Basic (plus machine language); 32 K; $9.95.

What is a REVERSIBLE GAME? You can stop the play at any point, back up and then do an "instant replay", analyzing your strategy. Or back up and resume the game at an earlier point, trying out a different strategy. Reversibility makes learning a challenging new game more fun. And helps you become a skilled player sooner.

WORLD OF ODYSSEY—a new adventure game utilizing the full power of Disk II, which enables the player to explore 353 rooms on 6 different levels full of dragons, dwarfs, orcs, goblins, gold and jewels. Applesoft II 48K; $19.95 includes diskette.

PERQUACKEY—an exciting vocabulary game which pits the player against the clock. The object of the game is to form words from a group of 10 letters which the computer chooses at random. The words must be 3 to 10 characters in length with no more than 5 words of any particular length. Each player has only 3 minutes per turn. The larger the words the higher the score. Applesoft II 16K; $9.95.

APPLESHIP—a naval game in which two players enter their ships in respective oceans. Players take turns trying to blast their opponent's ships out of the water. The first player to destroy their opponent's ships may win the game. A great low-res graphics game. Applesoft II 32K; $14.95.

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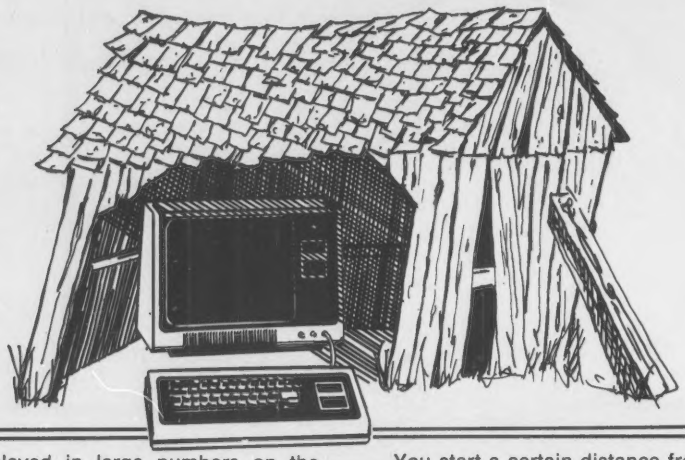
CIRCLE 118 ON READER SERVICE CARD

TRS-80 Strings



Stephen B. Gray

For column 14, we look at Creative Computing's Games-1 cassette, Radio Shack's service manuals for the video display and disk drive, an aircraft landing simulator, a technical article on the editor/assembler, the $30 fee for fixing your out-of-warranty CPU/keyboard, a short program that draws lines very easily, and an OEM note about the TRS-80 Model II.

We'll continue the series on computer graphics in the next issue. Some excellent entries have been received in response to the "square within a square" software challenge.

Games-1

For $7.95 at your local computer store, the Games-1 cassette from *Creative Computing* gives you five games for your 4K Level-I TRS-80.

The first is Battling Deathstars, an exciting real-time game for two players, in which you try to destroy the other ship without your own getting destroyed in the process.

Each of the two Deathstars is shown on the screen in the form of a white squre, with a corner cut out to indicate the gunport's location. Each player uses seven keys to control his ship. Four determine whether you head north, south, east or west. Two others rotate the ship, clockwise or counterclockwise. The seventh fires the gun.

You have to get quite close to hit the other ship, within 2½ inches on the screen. It's quite tricky to stop the rotation at the exact moment the gunport is aimed at the other Deathstar.

And a hit isn't always a kill. At times you may knock pieces out of the other ship, yet not destroy it. There's a lot to keep track of here, with seven keys to operate while keeping your eyes on the screen. When one ship destroys the other, the scores are displayed in large numbers on the screen. If the ships collide, the play starts over and no points are awarded.

Because this is a real-time game that would be too slow if written in BASIC, it's in machine language. The instructions tell you how to copy this game by using TBUG to change the data at a couple of addresses, and then putting it on tape with P4000 4FFFF. Why does *Creative Computing* tell you how to copy its own tape? "Because we're good guys," says publisher Dave Ahl.

The second game, Hangman, lets you cool down from the excitement of a duel in outer space with an intellectual exercise. For the few readers who may not have ever played hangman, the display presents a scaffold, the alphabet, a scoreboard and a row of dashes, one dash for each letter of the word you have to guess.

You guess a letter and, if it's in the word the computer has chosen, the letter appears in its correct place in the word, and disappears from the alphabet display. If you guess a letter that's not in the word, the head of the hanged man appears on the scaffold, then his torso, arms, legs, hands, feet, one by one as you select wrong letters. You can make only nine errors in guessing the word, and the computer keeps score on how many words you got right, and how many wrong, for as long as you want to play.

The program contains 26 words, 5 to 7 letters long. The instructions tell you how to change the word list, if you'd like to put in more difficult words.

The third game is Lunar Lander, which should NOT be played if you're easily overexcited. Because if you are, you might just heave your TRS-80 right out the window, after the twentieth failure to land your ship on the lunar surface!

You start a certain distance from the moon's surface, with a limited amount of fuel, and you must land gently. Use up your fuel too soon, and

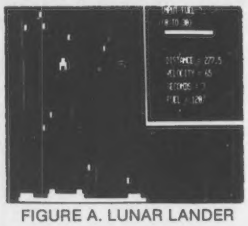


FIGURE A. LUNAR LANDER

you crash. Use too much, and you start moving upwards. *Very* tricky, and not designed for the easily discouraged.

The Math Race program first asks how difficult you want the game to be, on a scale of 1 to 10, whether one or two people will be playing, their name or names and ages. Then eight drawings are shown, including a giraffe, cat, bus and airplane. You pick one to be

FIGURE B. MATH RACE

your marker on the race track, as you solve math problems in competition with a friend or with the computer, and try to cross the finish line first.

The player's age and difficulty factor he's chosen will determine what math problems are given. The problems are given like this:

$$3586 + 4389 = ?$$

If you're playing against the computer, you lose if you make even one mistake, because the computer naturally never makes a mistake in math. Playing against a friend, you've still got a chance if you err.

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CIRCLE 199 ON READER SERVICE CARD

TRS-80 Strings, con't...

The fifth game is Checkers and, I must admit, the computer doesn't play a very good game. Sometimes it will move its pieces so that you can jump two or even three of them!

There wasn't enough space in the program to include routines to check on all the opponent's possible moves. The instruction sheet notes, "Remember to double-check your moves before entering them, because this 4K program does not include extensive error-checking features." The program is in two parts, with detailed instructions in the first part, including the comment, "The capabilities of this program are limited by the available memory (4K). The program does not look ahead, but instead evaluates the present situation and makes its moves based upon this evaluation. Just the same — I hope you have a lot of fun."

(The limitations of 4K, even for games less complex than Checkers, is the main reason why most games for the TRS-80 computers are being written for the 16K Level-II machine. There's already a move to disk for some of the really complex games.)

In several games of Checkers, the computer gave me an easy win. In some others, the computer kept moving a piece back and forth. Nevertheless, it's an interesting game you can enjoy despite its limitations.

So there you have five games: an exciting space duel, an intellectual spelling challenge, a highly difficult Lunar Lander, a math race for the younger set, and a Checkers game you can usually beat.

That's a pretty good combination for $7.95. If your local retail store doesn't have it, you can order from *Creative Computing* for $7.95 plus $1 for shipping and handling, plus five percent tax if you're a NJ resident. You can also order by phone: see the Sensational Software ad in this issue.

At this moment, the Games-1 tape is the only Level-I TRS-80 software offered by *Creative,* which is concentrating on the 16K Level-II games.

Two Service Manuals

If your video display isn't working, and if you're experienced in repairing TV sets, you might want to get the service manual. The manual is just about like most TV service manuals, because, as it notes, "Radio Shack's TRS-80 Video Display consists of RCA's model AA121S Television set which has been modified for use in Radio Shack's TRS-80 Microcomputer System." Selections of the manual are a direct pickup from RCA's Television Service Data File 1976 B-2.

The manual provides safety precautions, servicing information, critical lead dress, drawings of the chassis layout and the circuit boards, list of replacement parts, schematic, photos of 14 waveforms, and drawings of five video-interface waveforms.

The Video Display is an RCA TV set without the tuner, and with an added video-interface board. Except for that board, all replacement parts are available from "your RCA dealer."

The service manual for the floppy-disk drive is a lot thicker, as it contains a power-supply schematic and parts list, termination-resistor information, and the complete three-part Shugart "SA400 minifloppy diskette storage drive" service manual.

The Shugart manual includes 21 pages on theory of operation, very helpful and instructive, all about recording formats, drive-motor control, track accessing, read/write operations, etc. The 10-page maintenance section covers diagnostic techniques, preventive maintenance, removals and adjustments, component-location photographs, logic drawings, and schematics. The third section is an illustrated parts catalog.

To get either manual, go to the manager of your local Radio Shack store, and ask him to order it for you, from National Parts in Fort Worth.

Be sure to specify the Service Manual, because the same stock number is used for the product, the operator's manual, and the service manual. The Video Display Service Manual, 26-1201, is $3.00, and the Mini Disk Service Manual, 26-1160/1161, is $4.50. Plus postage.

Before you send for either manual, please note that, just as with keyboard/computer case, if you open up either the video-display case or the disk-drive case, you void the Radio Shack warranty.

Final Approach

Level IV Products Inc. (32238 Schoolcraft, Suite F4, Livonia, MI 48154) sells hardware and software for the TRS-80 only. The software includes business programs and utilities on disk, and games on cassette. From the catalog, one of the more interesting games seemed to be Final Approach, a Level-II item at $7.50.

According to one of the Level IV information sheets, this is an "aircraft landing simulator. You are flying a multi-engine jet and your job is to bring it down, but . . . there are hazards — fire, landing-gear malfunctions, stalling the plane and more."

After you load Final Approach, you get two screen pages of instructions giving you the meanings of the abbreviations to be used in the game display, such as A/S for airspeed indicator, R/D for rate of descent, DME for distance-measuring equipment (range in miles to the end of the runway), ALT for altitude, etc. The runway is 10,000 feet long. After the second page of instructions, you get the cheerful warning that This Aircraft Stalls At 110 Knots.

The game display consists of a simple graphics representation of the landing field in perspective, the readings of eight instruments (these initial readings change for every game) and a plane, represented (with wheels up) as

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--(*)-!-(*)--
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The game requires only two inputs from you, A/S and R/D. Seems simple enough, yet I crashed plane after plane, getting messages such as You Pranged It 1056 Feet Short Of Runway, followed by Let's Try It Again, Ace.

Drop below 120 knots, and you're likely to stall. Try to keep a proper R/D and you don't get low enough to land. Too much R/D and you crash. If you lower the landing gear too soon, or too late, it may malfunction. There's always the threat of fire. Very few hints are given in the instruction sheet. After five or ten crashes, you may feel tempted to give it up as a game that just can't be beaten, or maybe only by a professional pilot.

But hang on. Try to remember what sequence of events led to the lightest of your crashes, and before long you'll develop a strategy that will let you take on any combination of instrument readings and end up with

NICELY DONE —
YOU GREASED IT ON!

Level IV products runs a basement store, at the Livonia address, Tuesday through Saturday, from 11AM to 7 PM. They claim to be Michigan's largest software and hardware source for the TRS-80, with five employees. They have 1500 "bits of software," from many sources, the president told me, but sell only about 150. The rest either haven't been reviewed yet, or are so bad he just won't sell them.

If you're thinking you'd like to run such a store, the president of Level IV Products works 18 to 20 hours a day, seven days a week.

As this was being written, Level IV Products decided to drop all Level-I items, because the company hadn't had a request for anything in Level-I in three months.

Editor/Assembler

For a very good look at some of the inner workings of the TRS-80 editor/assembler, issue 12.0 of Insiders ($2 from Insiders, Box 32296, 2617 42nd St NW #2, Washington, DC 20007) carried a short article by Ray Soltoff that

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by Art Canfil from Cybernautics

This is an intriguing game set in the 1860's on the wild China Coast. George Blank said in 80-US, that he likes "it more than any of the other single player games." And Ramon Zamora of Recreational Computing found that it "is so intriguing that I played for over six hours when I first received a copy." $9.95.

pyramid of doom

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Adventure #8 is now available for you to explore. Will you be able to collect the treasures from the recently exposed pyramid? $14.95

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This is a scaled down version to give you a taste for adventure. $5.95

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You fly a multi-engined plane in for a ground controlled landing. Quite challenging. $7.50

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(German and French may be ready by the time you read this.)

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SYSTEM SAVERS

by Tom Stibolt from Acorn

If you ever use the SYSTEM command, you should buy this two program package. These programs allow you to save any system tape on tape or disk, plus offer several features for machine language programmers.

In Computer Cassettes Magazine, Robert Purser said that a tape duplication program "should be in everyone's library." We agree and beleive that System Savers is the perfect answer.

With FLEXL, which is one of the two programs, you can make back-up copies of any system format tape. Most often a cassette that you make will load easier than an orginal. This also protects the valuable copies of your system programs.

Plus you also find the filename on any system tape because it is displayed on the screen. If you ever forget to save a program file name, just use FLEXL to recover it. And at anytime you can stop the reading of the tape by simply pressing BREAK.

For any machine language programmer, FLEXL offers the advantage of producing more efficient tapes than the object files from the assembler. It is also written to interface directly with the Small Systems RSM-1 and other monitor programs. And machine language tapes can be merged following the prompting of the program.

Disk drive owners can use TDISK to save any system format tape onto disk. Sargon I, Adventure, Airaid, Editor/Assembler and other programs cannot normally be loaded to disk. Now, TDISK allows you to save these programs onto disk. After DOS READY you will be able to simply type the filename and be up and running. It even loads non-contiguous tapes. TDISK will greatly increase the benifit of owning a disk drive.

And as a FREE BONUS, Acorn Software Products, Inc. also provides complete instructions on how to load MicroChess 1.5 onto disk. A short BASIC program will let you play chess directly from disk.

Complete your system with the routines not found in either Level II or DOS for only $14.95. Order your System Savers, today!

DISASSEMBLER

by Roy Soltoff from Misosys & Acorn

This two pass Z-80 disassembler produces symbolic lables with output to either the video monitor, printer or tape. Radio Shack's Editor Assembler can load the tapes. If you own the Editor Assembler, complete the package with this program. Program on tape for two different memory locations. TRS Level II $19.95

BASIC TOOLKIT

by F. Barry Mulligan from TBS

If you program in BASIC, you can use this package. This easy-to-use machine language utility will save you time and and effort.

The use of variables in BASIC programming can often get rather complicated. While you can keep track of where each varialbe is used, why not let the computer do that work? Well, this program lets the computer do just that. It produces a "map" alphabetically listing the variables in any of your BASIC programs and gives the line number where they are used.

In addition, the program displays a listing of each line number jumped to followed by the lines from which the jumps are made. This includes all GOTO's, GOSUB's and RESUMEs. This can be especially important when trying to limit the number of lines in a program or before making any changes to a subroutine.

Esides these two 'tools' you can also merge BASIC programs from cassette, recover any programs 'lost' by an accidental NEW, and test the computer's memory. And all of these functions are available from a single keystroke while you are working on your BASIC program.

For these features and more, order your 'Toolkit' today! $19.80.

PACKER

by Cottage Software

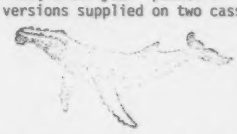
This is the ultimate editing tool for BASIC program lines. There are five commands which allow easier reading of BASIC programs and more efficient execution by the computer.

The 'unpack' command breaks multiple statement lines into single statement lines with extra spaces for easier reading and editing. The 'short' command deletes any unnecessary words like LET and all REMarks.

The 'pack' command compresses lines into multiple statement lines up to the maximum length you specify while maintaining complete program logic. This can easily reduce the memory requirement by more than 33%! As you can imagine this also speeds up execution of a program, saves time in loading a program from either tape or disk and saves disk space.

With the 'renumb' command you can renumber your BASIC lines. And the 'move' command allows you to move any section of your program to a new location.

So if your programs need more memory, or you need more time, order your 'packer'! 16k, 32k and 48k versions supplied on two cassettes for $29.95.



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TRS-80 Strings,con't...

should interest computerniks who understand sentences such as "The E/A uses address 5CF9 as the start of the text buffer."

Soltoff writes, in part, "The E/A was designed to work with both a Level I and a Level II machine. This is possible because the package includes essentially a duplicate of the routines found in a Level II ROM for output to Video and Printer, Keyboard input and input/output of Cassette. Thus, once loaded, the program is independent of Level I or II. The one drawback of this operation for Level II users, is that the program loads partially in a region of memory reserved for Level II RAM variables. It is for this reason that a RESET operation will 'destroy' your program and necessitate a reload. What happens is that a RESET will result in BASIC's reinitialization of variables which occur in a RAM area also used by the E/A's variables."

For more on the subject, see issue 12.0, which also has a brief article on some of the intricacies of using USR in Level II BASIC, such as how to avoid hanging up the TRS-80, or wiping out your program, once you go to a machine-language routine.

A subscription to Insiders, by the way, is $7.50 for six issues; outside North America, $15.

$30 If Unopened

Many TRS-80 owners may not realize that Radio Shack will repair their CPU/keyboard units for a flat $30 if it's out of warranty. That is, if the case has not been opened. Even the main PC board will be replaced if it's faulty. But if the case has been opened, replacing that main board could cost the user $300.

The original set price for this out-of-warranty service was $24, until Radio Shack accumulated enough experience with such service to find out that they should have been charging $30.

This low-cost flat service fee for the CPU/keyboard repair has been in effect from the beginning, but it hasn't been publicized very much, a Radio Shack executive told me. Perhaps by the time you read this, it will have been. The more TRS-80 owners who know about it, the fewer will be tempted to tinker inside the case.

Short Program #6

Bill White of Twin Falls, Idaho, sent this:

"Here are two short programs you might like. Type 1-8 to draw a line in these directions:

FIGURE C.

Type a "9" and a dot moves, crossing its previous step.

```
10 CLS:REM DRAWING PROGRAM
   BY BILL WHITE 1979
20 PRINT @ 896, " ";:INPUT E
40 IF E=1 THEN B=1:
   IF E=1 THEN D=-1
50 IF E=2 THEN B=2:
   IF E=2 THEN D=0
60 IF E=3 THEN B=1:
   IF E=3 THEN D=1
70 IF E=4 THEN B=0:
   IF E=4 THEN D=2
80 IF E=5 THEN B=-1:
   IF E=5 THEN D=1
90 IF E =6 THEN B=-2:
   IF E =6 THEN D=0
100 IF E=7 THEN B=-1:
   IF E=7 THEN D=-1
110 IF E=8 THEN B=0:
   IF E=8 THEN D=-2
112 IF E=9 RESET (A+63,C+35)
113 IF E=9 RESET (A+63-B,C+35-D)
115 A=A+B:C=C+D:SET(A+63,C+35)
120 GOTO 20
```

You may wish to write in a line or two to prevent the line from going too close to the screen edge."

Bill's second program is almost the same as the first, except that the values of B and D in lines 40-110 are divided by two, so that line 40, for example, becomes:

```
40 IF E=1 THEN B=.5:
   IF E=1 THEN D=-.5
```

In the first program, the horizontal and vertical lines are dotted; in the second, solid, as the printout shows. The printout, on a Screen Printer, is somewhat deceptive, because the graphics blocks show as square, not rectangular.

If any 1-9 key is to be used more than once at a time, it need not be held down to continue the same action; just keep depressing ENTER until you need to change direction.

For a simple design, using the first program, depress ENTER three times for each of these keys: 1-7-2-1-3-2-5-3-6-5-7-6. Can you figure out which keys to use to approximate this same design using the second program?

Lines 40-110 contain much repetition. Can you reduce or eliminate this? Can you do it with an ON/GOTO?

Tandy to OEM the Model II

Moving outside its network of over 6,000 Radio Shack stores, Tandy Corp. will sell its TRS-80 Model II to firms that will add software and sell the computer under their own name or the Tandy label.

A newly created group, the Tandy Contract Marketing Division, will market what the division calls, for marketing purposes, the "Tandy II," to software companies involved in turn-key-system sales.

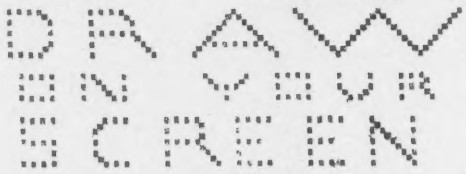

FIGURE D.

Not only has the name been changed for the OEM market, but the color of the case has been changed from silver to light blue.

(OEM, when spelled out, is something of a misnomer, because it stands for Original Equipment Manufacturer, although most computer OEMs do not manufacture the hardware, but only add software). □

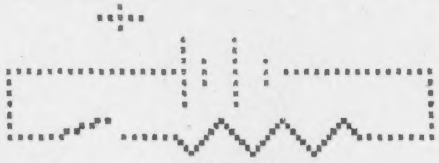
FIGURE E.

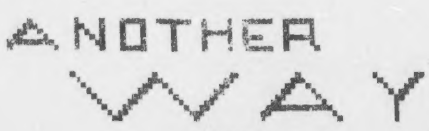

FIGURE F.

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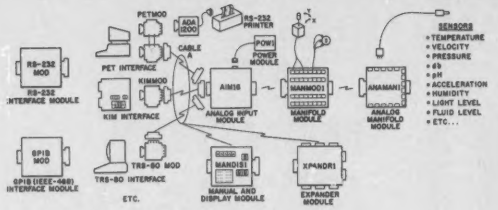

The world we live in is full of variables we want to measure. These include weight, temperature, pressure, humidity, speed and fluid level. These variables are continuous and their values may be represented by a voltage. This voltage is the analog of the physical variable. A device which converts a physical, mechanical or chemical quantity to a voltage is called a sensor.

Computers do not understand voltages: They understand bits. Bits are digital signals. A device which converts voltages to bits is an analog-to-digital converter. Our AIM16 (Analog Input Module) is a 16 input analog-to-digital converter.

The goal of Connecticut microComputer in designing the DAM SYSTEMS is to produce easy to use, low cost data acquisition modules for small computers. As the line grows we will add control modules to the system. These acquisition and control modules will include digital input sensing (e.g. switches), analog input sensing (e.g. temperature, humidity), digital output control (e.g. lamps, motors, alarms), and analog output control (e.g. X-Y plotters, or oscilloscopes).

Analog Input Module

The AIM16 is a 16 channel analog to digital converter designed to work with most microcomputers. The AIM16 is connected to the host computer through the computer's 8 bit input port and 8 bit output port, or through one of the DAM SYSTEMS special interfaces.

The input voltage range is 0 to 5.12 volts. The input voltage is converted to a count between 0 and 255 (00 and FF hex). Resolution is 20 millivolts per count. Accuracy is 0.5% ± 1 bit. Conversion time is less than 100 microseconds per channel. All 16 channels can be scanned in less than 1.5 milliseconds.

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The POW1 is the power module for the AIM16. One POW1 supplies enough power for one AIM16, one MANMOD1, sixteen sensors, one XPANDR1 and one computer interface. The POW1 comes in an American version (POW1a) for 110 VAC and in a European version (POW1e) for 230 VAC.

AIM16... $179.00
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Connectors

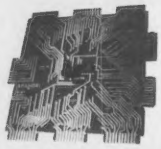
The AIM16 requires connections to its input port (analog inputs) and its output port (computer interface). The ICON (Input CONnector) is a 20 pin, solder eyelet, edge connector for connecting inputs to each of the AIM16's 16 channels. The OCON (Output CONnector) is a 20 pin, solder eyelet edge connector for connecting the computer's input and output ports to the AIM16.

The MANMOD1 (MANifold MODule) replaces the ICON. It has screw terminals and barrier strips for all 16 inputs for connecting pots, joysticks, voltage sources, etc.

CABLE A24 (24 inch interconnect cable has an interface connector on one end and an OCON equivalent on the other. This cable provides connections between the DAM SYSTEMS computer interfaces and the AIM16 or XPANDR1 and between the XPANDR1 and up to eight AIM16s.

ICON... $ 9.95
OCON... $ 9.95
MANMOD1... $59.95
CABLE A24... $19.95

XPANDR1



The XPANDR1 allows up to eight AIM16 modules to be connected to a computer at one time. The XPANDR1 is connected to the computer in place of the AIM16. Up to eight AIM16 modules are then connected to each of the eight ports provided using a CABLE A24 for each module. Power for the XPANDR1 is derived from the AIM16 connected to the first port.

XPANDR1 . . . $59.95

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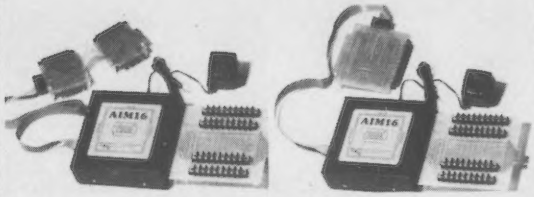

For your convenience the AIM16 comes as part of a number of sets. The minimum configuration for a usable system is the AIM16 Starter Set 1. This set includes one AIM16, one POW1, one ICON and one OCON. The AIM16 Starter Set 2 includes a MANMOD1 in place of the ICON. Both of these sets require that you have a hardware knowledge of your computer and of computer interfacing.

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```
POKE59426,N:POKE59426,255:X=PEEK(59471):PRINT"CHANNEL "N"="X
```

are all that is needed.

The KIMMOD plugs into the COMMODORE KIM applications connector and provides one application connector and one DAM SYSTEM'S port. The KIMMOD is connected to the AIM16 or XPANDR1 with CABLE A24. Assembly and machine language programs for reading and displaying data are included. The KIMSET1 includes one KIMMOD, one CABLE A24, one AIM16, one POW1 and one MANMOD 1.

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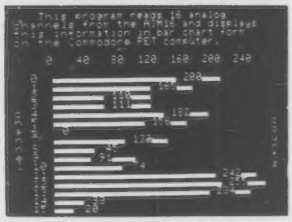
This program reads 16 analog
channels from the AIM16 and displays
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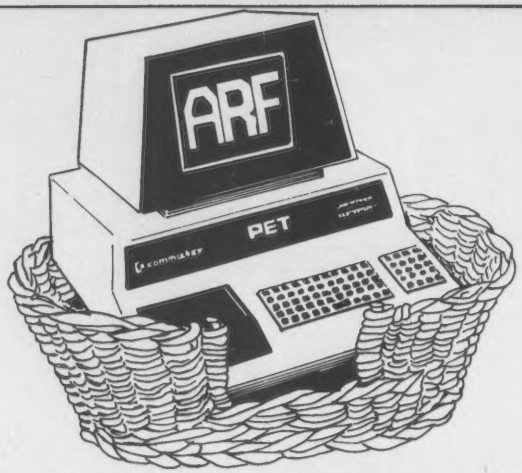


I am happy to hear from you, and encourage your correspondence. I will try to acknowledge all correspondence, and a SASE makes things easier for both of us. Please send your letters to "Personal Electronic Transactions" c/o PO Box 354, Palo Alto, CA 94301.

A Quickie for You

Some of you know of a programming language called APL. In APL, programs can be written very precisely — and among APL programmers there is the "One-Line Program Syndrome." One programmer will write a line of heiroglyphics and hand this to another programmer, along with the statement: "Guess what **this** does!"

The PET permits some interesting short programs in BASIC, and if you come up with something interesting, and shorter than 10 lines, send it in. (The PET User Notes, PO Box 371, Montgomeryville, PA 18936, often prints 4-line or shorter programs, and I am happy to indulge in "Imitation is the best form of flattery.") Dan Rubis sent me a 3-liner that can be of some use:

```
10 DIMA$(16):FORI=1TO16:READA$(I):NEXT
20 INPUTH$:C=0:FORI=1TO4:FORJ=1TO16:IF
   MID$(H$,I,1)=A$(J)THENC=C+(16↑(4-I))*(J-1)
30 NEXTJ:NEXTI:PRINTC:GOTO20:DATA 0,1,2,3,4,5,6,
   7,8,9,A,B,C,D,E,F
```

This critter asks for a 4 digit hexadecimal number and prints the decimal result. For example:

```
RUN
? 1000
 4096
? FFFF
 65535
```

That's fine — and Dan cautioned me that this program likes 4 digit entries. If you try entering just "1", you get 4096 back! A little bit of fiddling makes everything well, however:

```
10 G=16:DIMA$(G):FORI=1TOG:READA$(I):NEXT
20 INPUTH$:FORI=1TOLEN(H$):FORJ=1TOG:IFMID$
   (H$,I,1)=A$(J)THENC=C*G+J-1
30 NEXTJ,I:PRINTC:C=0:GOTO20:DATA 0,1,2,3,4,
   5,6,7,8,9,A,B,C,D,E,F
```

Fool with this one for a while — it is much more tolerant of input errors! (And runs a shade faster too.) Here are the tricks I used:

1) I converted the value 16 into the variable G — this was mostly to save some room in Line 20 which was getting a bit crowded!

2) The FOR I loop was changed to look at all of the characters in H$ — and if H$ was short, the I loop would only look that far.

3) When a hexadecimal digit was found, just multiply the current value by 16, and add the new digit — which is simpler than the first method, **and** permits the ignorance of "junk" characters without increasing the value of C.

4) For the sake of room, I used the NEXT J, I form, and moved the C=0 to Line 30 to make more space in Line 20.

If your entry is not the best BASIC code in the world, don't worry! I am interested in the **ideas** within a program, and cleaning-up of code is part of my meticulous nature. I do so to share the "tricks of the trade" with you, and to teach programming methods in an unobtrusive manner.

The next project is to do the reverse feat of converting a decimal number to hexadecimal. (See PET User Notes, Nov-Dec 1978, Page 21 for one approach.) My result is:

```
10 H$="0123456789ABCDEF":GOTO30
20 P=INT(D/16):Q=D-16*P:A$=MID$(H$,Q+1,1)
     +A$:IF P>0THEND=P:GOTO20
30 PRINTA$:INPUTD:A$="":GOTO20
```

Line 20 computes Q to be the remainder after dividing D by 16. The correct character is added to A$, which is built left-to-right. When this is finished, the result is in A$ for your viewing.

A Formatting Program

Let's take the bull by the horns and try to make a reasonably useful subroutine for formatting numbers. A completely flexible routine would take too much space — but a simplified version will illustrate what has to be done. (If any of you elaborate on this routine, send me a copy!)

The steps to a formatting program are:

1) Decide on how to specify the desired format. The various versions of "PRINT USING" are a guide for this.

2) Conver the number that is to be printed into a string. (That's easy. Use STR$.)

3) Convert the number's representation into fixed point format. (If the PET served up 8.12E-04, convert this to .000812).

4) Check the format specification to match up the decimal point's location, and then remove any extra less significant digits. If the number is too large, signal the error. (One way is to print asterisks instead of digits.)

More elaborate routines can go on to:

5) Check the specification for signs and place properly — for example, add "+" to positive numbers, and put in the desired column. (+ 123 vs +123 & so on).

6) Add leading and trailing zeroes as needed.

7) Decide whether to suppress a trailing decimal point for integer numbers. (Change 12345. to 12345).

There are several ways the PET displays a number, depending on its value:

Integer	123
Fixed Point with Decimal	1.23
Scientific Form	1.23E+15

First, let's make a short program to do Step 2, and to allow entry of test numbers:

```
10 PRINT"clr TEST FORMAT ROUTINE"
20 INPUT"NUMBER sp sp sp sp sp sp sp sp :";N
30 PRINT"PET SEES IT AS:"N
40 GOSUB 9000
50 PRINT"FORMAT SEES sp sp sp:"R$
60 PRINT
70 GOTO 20

9000 REM FORMAT ROUTINE
9010 REM CONVERT TO STRING
9020 R$=STR$(N)
9030 RETURN
```

When this is RUN, we get a display of the three views of our number:

PET, con't...

```
RUN
(screen clears)
TEST FORMAT ROUTINE
NUMBER       :? 123              (You enter 123)
PET SEES IT AS: 123
FORMAT SEES   : 123

NUMBER       :? .000123
PET SEES IT AS: 1.23E-04
FORMAT SEES   : 1.23E-04
```

When debugging the program these three views will prove beneficial. As you will notice, the PET likes to change your entered number's format, so the formatter won't see the number you entered in the same way as you do.

For convenience in handling, I chose to have the format routine see a number as:

(Sign)(Mantissa)(Exponent)

The mantissa would always be a fraction — i.e., 8.23 would be seen as:

(+)(823)(+1)

Note the mantissa assumes a decimal point as the first character.

The first task is to break the STR$ string into these parts:

```
9030 REM FETCH SIGN
9040 S$=LEFT$(R$,1)
9050 R$=MID$(R$,1)
9060 REM CHECK IF SCIENTIFIC
9070 FORJ=1TO LEN(R$)
9080 IF MID$(R$,J,1)="E"THEN 9210
9090 NEXT J
9100 REM NOT SCIENTIFIC FORM
9110 REM SCAN FOR DEC PT
9120 FOR J=1 TO LEN(R$)
9130 IF MID$(R$,J,1)="." THEN 9180
9140 NEXT J
9150 REM NO D.P. MEANS INTEGER
9160 M$=R$:E=LEN(R$):GOTO 9310
9170 REM CONVERT FIXED POINT
9180 E=J-1: IF E=0 THEN 9310
9185 M$=LEFT$(R$,E)+MID$(R$,E+2)
9190 GOTO 9310
9200 REM SCIENTIFIC FORM
9210 E=VAL(MID$(R$,J+1))+1
9220 R$=LEFT$(R$,J-1)
9230 M$=LEFT$(R$,1)+MID$(R$,3)
9300 REM SHOW PARTS
9310 R$=" SGN:"+S$+" MANT:"+M$+" EXP:"+STR$(E)
9320 RETURN
```

This complicated code "parses" the string R$ into the parts S$ for the sign, M$ for the mantissa, and E for the exponent.

A RUN will show some examples:

```
TEST FORMAT ROUTINE
NUMBER       :? 123456
PET SEES IT AS: 123456
FORMAT SEES   : SGN:  MANT:123456 EXP: 6

NUMBER       :? 45.26E-12
PET SEES IT AS: 4.526E-11
FORMAT SEES   : SGN:  MANT:4526 EXP:-10
```

This looks pretty good — 123456 is .123456 times 10^6 and so on. However, a test of values like .0345 doesn't work very well (Try it!). It is important to try **all** combinations with programs like this — or take a lot of embarrassment.

The first fix is:

```
9180 E=J-1:IF E=0 THEN M$=R$: GOTO 9310
```

This gets the mantissa back — but the mantissa will still have a leading zero for values like .0234. A better fix is:

```
9180 E=J-1:IF E>0 THEN M$=LEFT$(R$,E)+MID$(R$,E+2)
     :GOTO 9310
9185 M$=MID$(R$,2)
9187 IF LEFT$(M$,1)="0"THEN R$=M$:E=E-1:GOTO 9185
```

Now all is well — and another bug (I won't tell what!) has vanished also. A look at the code is instructive.

My approach is to handle the formatting as a pure "numbers as strings" approach — all tests and manipulations are in the form of string operations. There are cases where the PET won't test numbers accurately, and R$ already has the value that the PET wants to print.

Line 9040 takes the first character, which will be a space or the minus sign, and puts it into S$ for later reference. Line 9050 "snips off" this character from R$ since we don't need it any more.

Lines 9060 to 9090 look through the number for the letter "E" which tells us if a number is in Scientific Notation. If we have Scientific Notation, the number is always in the form:

D.DDDD . . . E±DD

In Line 9210 we make E equal to the value of the exponent by looking at the portion of the string **after** the "E." When we make the mantissa to the form desired, a division by 10 will take place, forcing the value of E to become one more — so this is also done in advance in Line 9210.

9220 removes the part with the "E" and the exponent since it isn't needed now. Line 9230 rearranges the remaining digits to remove the decimal point — in Scientific form, the decimal point is always in the second position. Lines 9300 to 9320 re-compose R$ as a test display for debugging.

If the number isn't in Scientific form, it is either an integer or a fixed point number. Lines 9120 to 9140 look for the decimal point as a way to telling. If a decimal point isn't found, Line 9160 creates the mantissa by just taking the digits. Since integers imply a decimal point at the right end of the number, the exponent is simply the length of the digits string! (Nice, huh?)

Fixed point numbers are a bit tricky — we have several kinds:

```
123.456
 1.23456
  .123456
 .0123456
```

The first two examples, where a digit **precedes** the decimal point, are handled in Line 9180. E is the position of the decimal point less one, and the string formula removes the decimal point from the digits string R$.

If E is zero, we have one of the two remaining cases — the first case is to just remove the decimal point in Line 9185. However, in some cases, the number will have a leading zero, which is checked for in Line 9187. By jumping to 9185, an unlimited number of leading zeroes can be removed, though this isn't required for the PET.

(My real motive is to re-use the code in Line 9185 to destroy the zero — and why not? It is **my** program, after all!)

Now that the number has been "crunched," let's take a look at Steps 1 and 4. As this program is an example, I will use the format specifier F$ as:

```
F$ = "DDDDDD.DDDDD"
```

Here the number of leading digits is specified by the number of "D"s before the decimal, and the number of trailing digits by the number of "D"s after the decimal. If the letter "S" appears as the first letter, the sign will be printed in this position. Otherwise, the sign won't be printed at all. (Gives you something to think about.)

If a number is too large to fit, asterisks will be printed instead. Small numbers will have leading zeroes added, and trailing zeroes will always be added to fill the space after the decimal with digits. If no decimal point appears in F$, the integer value will be printed.

Whew! Here is the code to add:

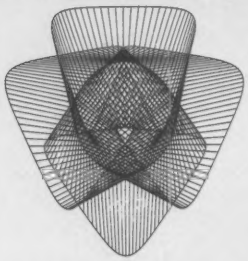
```
9300 REM ANALYSE FORMAT STRING
9310 REM PUT SIGN IN R$ IF NEEDED
9320 R$="":F1$=F$
9330 IF LEFT$(F$,1)<>"S" THEN 9370
9340 IF S$=" " THEN S$="+"
9350 R$=S$:F1$=MID$(F$,2)
9360 REM GET # OF D'S ON BOTH SIDES
9370 F1$=F1$+"!"
9380 FOR J=1 TO LEN(F1$)
9390 IF MID$(F1$,J,1)="D" THEN NEXT J
9400 D1=J-1
9410 F1$=MID$(F1$,J+1)
9420 D2=LEN(F1$)-1
```

Let's have a look at what this does. Lines 9310 to 9350 check the format string for the letter "S" which means that the sign is to appear. Since scanning the format string is going to take it apart, F1$ is used instead — so F$ is preserved. Line 9340 replaces a blank with the "+" for positive numbers. In Line 9350, F1$ has any "S"s removed.

The next step is to find D1, the number of "D"s on the left side, and D2, the number of "D"s on the right. The "!" is added to F1$ to prevent a disaster when the scanning loop goes past the end of F1$. (The PET string functions hate to see zero as their numeric arguments — so devious tricks must be done to prevent this awful event.) Note the odd construction of the loop — it keeps going until a non-"D" is seen (This will be "." or "!").

When the loop stops, D1 is known — see Line 9400. D2 is known indirectly — as what's left over. Line 9410 makes F1$ the "left over" part on the right of the decimal (or "!"). Line 9420 is a nasty trick. First, it is possible to have no decimals on the right, but a decimal point, such as "DDDDD." This makes D2 zero (Remember that the "!" was added to F1$ earlier.) An integer format, like "DDDD" makes D2 -1 — this is a handy flag for this case for later.

Now for more code.



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PET, con't...

```
9500 REM BUILD NUMBER AS FIXED PT
9510 REM RL$=LEFT SIDE
9520 REM RR$=RIGHT SIDE
9525 RL$="":RR$=""
9530 REM REMOVE TRAILING ZEROES FROM M$
9540 M$="0"+M$
9550 IF RIGHT$(M$,1)="0" THEN M$=LEFT$(M$,LEN(M$)-1)
     :GOTO 9550
9560 M$=MID$(M$,2)
9570 REM SET ZERO FLAG
9580 ZF=0:IF M$="" THEN ZF=1
9590 REM BUILD LEFT SIDE
9600 REM ADD ANY TRAILING ZEROES
9610 IF ZF THEN RL$="0": GOTO 9710
9620 IF E <= LEN(M$) THEN 9650
9630 RL$=M$:FORJ=1 TO E-LEN(M$):RL$=RL$+"0"
     :NEXT: GOTO 9710
9640 REM NO TRAIL ZEROES
9650 IF E<1 THEN RL$="": GOTO 9710
9660 RL$=LEFT$(M$,E)
9700 REM BUILD RIGHT SIDE
9710 REM SEE IF ANY RIGHT SIDE
9720 IF E>= LEN(M$) THEN RR$="":GOTO 9820
9730 REM ADD ANY LEADING ZEROES
9740 IF E>=0 THEN 9770
9750 M$="0"+M$:E=E+1:GOTO 9740
9760 REM CHOP OFF
9770 M$="1"+M$:RR$=MID$(M$,E+2)
```

The objective here is to make two strings, RL$ and RR$, which hold the number in fixed point form, with any leading or trailing zeroes added. We begin by noticing that a number like 1000000 will end up in M$ as "1000000" since no precautions were made for trailing zeroes. Lines 9540 to 9560 get rid of these. If the number originally was a true zero, this leaves M$ as a null string. Lines 9570 and 9580 take note of this by setting a flag, ZF.

Now it's time to get the left-hand side of our number. If the number is zero, it's simple — the string is a "0". Line 9610 checks this one.

E, our exponent, is handy for locating the position of the decimal point in the mantissa. If the mantissa is shorter than the value of E, some trailing zeroes must be added. (Around this time I had to resort to pad and pencil to see what's what.) Lines 9620 and 9640 add any needed zeroes. The value E-LEN(M$) tells how many zeroes to add.

If E is less than one, there isn't a left-hand side. See Line 9650. Line 9660 is the "normal" case where all is well-behaved. (Hah!)

Ho Hum, and it's time to do the right side. Line 9720 sees if there is one at all . . . M$ has to be longer than E characters here. In Lines 9740-9750 the reverse problem of leading zeroes is handled. Each leading zero means that E is increased by one, and eventually E will reach zero — then Line 9770 takes the scissors and makes the right side at last.

If you are determined to make all this work, use a pencil and pad to draw your numbers, mantissas, etc. Diagrams are a great help.

Now that the number has been reconstituted and the format specification analysed, it is time to create the formatted result. The value of D2 lets us distinguish between pure integers without decimal points and fixed point values. The pure integer case is handled as follows:

```
9800 REM BUILD RESULT FROM ALL THIS
9810 REM DO PURE INTEGER CASE
9820 IF D2>-1 THEN 9950
9830 REM OVERFLOW
9840 IF LEN(RL$)>D1 THEN FOR J=1 TO D1:
     R$=R$+"*":NEXT:RETURN
9850 REM ADD LEADING SPACES
9860 IF LEN(RL$)=D1 THEN R$=R$+RL$:GOTO 9890
9870 RL$="sp"+RL$:GOTO9860
9890 REM FIX FOR ZERO
9900 IF RIGHT$(R$,1)="sp" THEN R$=LEFT$
     (R$,LEN(R$)-1)+"0"
9910 RETURN
```

A value of D2 that is -1 means an integer is at hand. Line 9820 checks for this. If the right-hand result is longer than D1, the number of digits allowed in the format, the number is too large. Line 9840 checks this, and builds the rest of R$ into asterisks to indicate the problem. There is no use in going further in this case, so we RETURN.

When the result, RL$, fits the space in the format, our job is done (almost). Lines 9860 and 9870 add blanks in front until a fit is found.

Sometimes the number is a fraction, like .123. When RL$ was created, a fraction returns RL$ as a null string — now filled with blanks. As far as we are concerned, the value of zero, so Line 9900 checks and the last digit, and replaces a space with a zero if needed. At last! We are done with the integers.

The non-integer case is handled by this code:

```
9920 REM NOT AN INTEGER
9930 REM LEFT SIDE
9950 REM OVERFLOW ?
9960 IF LEN(RL$)>D1 THEN FOR J=1 TO D1+D2+1
     :R$=R$+"*":NEXT:RETURN
9970 REM ADD LEADING SPACES
9980 IF LEN(RL$)=D1 THEN R$=R$+RL$:GOTO 10010
9990 RL$="sp"+RL$:GOTO 9980
10000 REM RIGHT SIDE
10010 R$=R$+".":IF D2=0 THEN RETURN
10020 REM TRAILING ZEROES
10030 IF D2<LEN(RR$) THEN 10050
10040 RR$=RR$+"0": GOTO 10030
10050 R$=R$+LEFT$(RR$,D2)
10060 RETURN
```

Lines 9920 to 9990 act in the same way as Lines 9840 to 9870. Note that the filling with asterisks must fill the entire format specification, D1+D2+1 (recall the decimal point!)

Line 10010 adds the decimal point, and if there is no right side, we are done. In 10030 to 10040, the length of the right side RR$ is checked, and zeroes are added until RR$ is longer than the right-side format. Line 10050 trims off the excess, and we are done!

To test these formats, insert:

```
15 INPUT"FORMAT STRING:";F$
```

Take this routine and use it in your programs — and see if it is of any use to you. A lot of "shrinking" can be applied — my approach was to do everything in tiny steps so I knew how my bugs worked! □

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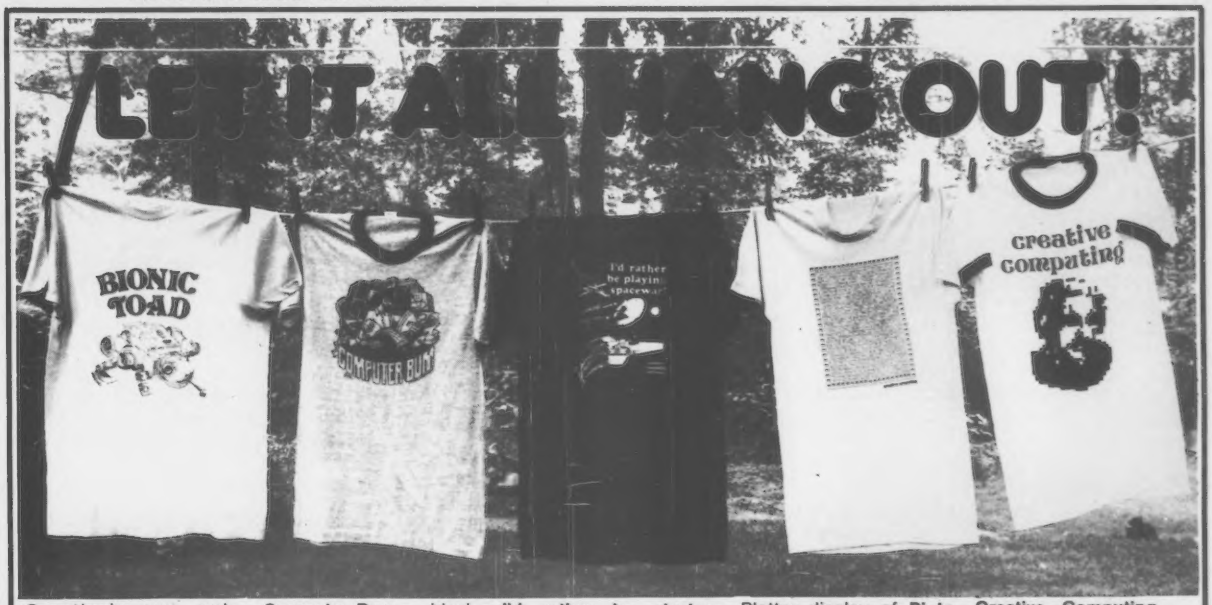

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Copyright Infringement Versus Permissible Use

Harold L. Novick

Excitement is in the air! This is the holiday season and the courts, following the custom during this period, have provided us with some gifts in the form of two new decisions in the area of copyright infringement. The decisions are either good news or bad news, depending, respectively, upon whether one is the copier or the "copiee." (There is no such word, of course; but that fits in with there being no clear guidelines in the area of software protection.)

In the first decision, a Federal District Court judge, speaking only for the Central District of California, held that it is not a copyright infringement to copy television programs, including movies, broadcast over the airways with a videotape recorder for non-commercial use in a person's home. This is the well known Betamax case (**Universal City Studios, Inc. v. Sony Corp.**, 203 USPQ 656).

The second copyright case was decided by a Chicago judge who held that an "object computer program" stored in a ROM is a mechanical tool or a machine part, but is not a "copy" of the source program. This is the CompuChess case, and it said that there is no copyright infringement in duplicating a ROM from the CompuChess computerized chess game and using it in another computer chess game. (**Data Cash Systems, Inc. v. JS&A Group, Inc.**, 203 USPQ 735.

Copyright infringement is the violation of the copyright owner's exclusive rights by the unauthorized copying, preparing of derivative works, distributing copies, publicly performing or publicly displaying the copyrighted work. The October, 1979 Software Legal Forum discussed copyright infringement and also mentioned, without elaboration, that these five exclusive rights had six limitations and six restrictions on the scope of the rights.

The limitations on the rights are "fair use" of the copyrighted work; reproduction by libraries and archives of the copyrighted work; sale or display by a legal owner of a copyrighted work; performance or display of a copyrighted work by a non-profit educational, religious, or governmental insitution; certain secondary transmissions (e.g., rebroadcasts); and certain ephemeral recordings (e.g., archival copies). The particular restrictions on the scope of the rights, however, are extremely detailed. In general and with some limitations, they permit anyone to do the following for the specified categories of copyrighted works: perform and imitate the sounds captured in sound recordings; make and distribute phonorecords of nondramatic musical works upon the payment of a set fee; publicly perform sound recordings in coin-operated phonorecord players (e.g., juke boxes); and use certain works in connection with non-commercial broadcastings. The two remaining restrictions state that the new copyright law does not cover the making of a useful article portrayed in pictorial, graphic and sculptural works and the use of a copyrighted work "in conjunction with" computer systems.

The Betamax and CompuChess cases illustrate applications of these limitations and restrictions. In the Betamax case, the court permitted home use recording of broadcasted programs on the basis of the "fair use" limitation. "Fair use" is the ability of someone other than the copyright owner to use the copyrighted material in a reasonable manner without the owner's consent. In the computer software area, an example of "fair use," in this author's opinion, is the making of back-up copies of software stored on floppy diskettes.

In the CompuChess case, the court held that the copying of the ROM was not a copyright infringement because the new Copyright Act was limited in the scope of its coverage and did not encompass the use of a work in a computer. The copying may, however, be unlawful under the state doctrine of unfair competition, so no one should rush out and start copying programs from ROM's.

The judge in the CompuChess case also made the astonishing statement that object programs "cannot be understood by even the most highly trained programmers." Then, contrary to the assumptions of the parties in the law suit, the judge followed with the unbelievable holding that, "While the ROM is the mechanical embodiment of the source program, it is not a 'copy' of it." Amazing! With this type of judicial decision making, how can one

Harold L. Novick, Patent Attorney, LARSON, TAYLOR & HINDS, Arlington, VA 22202

Legal Forum, con't...

criticize Michael Shrayer Inc. for not suing Vector Graphics under the copyright laws? (see Dec. 1979 Forum)

The CompuChess case, however, can be used as an example to help answer Mr. Norman Whaland's question asked in last month's Forum. He wanted to know the difference between "derivative works," which are modifications of a copyrightable work and are protectable, and ideas, procedures and concepts which are not protectable by copyrights. The judge cited an earlier case which held that "a completed building is not a copy of the architectual plans upon which the building is based." Blueprints are expressions of an idea and are capable of being copied in the copyright sense only by similar technical writings. The ideas embodied in the blueprints are used to build the building. To extend copyright coverage to the building itself would be to extend the copyright from the written expression of the ideas to the ideas themselves.

Another example, closer to personal computing, is that an electrical schematic is the expression (copyrightable), whereas the circuit built using the schematic is the object itself (not copyrightable). In the CompuChess case, the judge held, in effect, that the ROM is analogous to a hand wired circuit and the source program and flow charts are analogous to an electrical schematic. One more example. A book describing the input format for data to be entered into a computer is copyrightable. One cannot copy the book. But the copyrighting of the expression of the procedure in the book cannot prevent someone from adopting the same procedure. For example, someone can write an interactive computer program which asks prompting questions to enter into the computer the same data that is called for by the book without infringing the book's copyright. The writing describing the procedure is protectable, the procedure itself is not. The use of the procedure is different from the rewriting of the written expression of the procedure. Has the point been cleared up Norman, or has it been further obfuscated?

So where does this leave us? What is fair use and what is a copy of a computer program? The commendable Betamax decision adopted a practical solution. But it certainly does not end the controversy. Maurice Nunas of Dynamic Information Technologies, Dieppe, NB, Canada continues the controversy by suggesting another "practical solution" to the problem of providing machine readable software. His lengthy letter, and Steve North's response conclude this month's forum. Query, is Maurice's "solution" a copyright infringement?

Dear Creative Computing:

I've been reading with interest the letters and editorials that you have been publishing concerning the "piracy" of software. While for the most part, I agree with your stance, our views part company to some extent where CP/M is concerned.

Our company sells CP/M business systems. In addition, most of us at DIT are "dyed-in-the-wool" hobbyists. Thus, being close to both worlds, I can see a case for both sides.

Software companies such as your own, individuals who write software for distribution, and systems companies such as our own require protection against the theft of our products. In order to have this protection it seems to me that a special set of copyright regulations must be promulgated. The existing copyright legislation is simply not up to date with advances in the state of the art. On the other hand, I have sympathy for the computerist who may have difficulty in obtaining software in machine readable format for his machine. Certainly, we need the listings in the magazines for many reasons but surely manually "banging-in" thousands of lines each is not what a new set of copyright regulations should mean. In the computer world surely there is some onus on the distributor/writer/copyright holder.

Your software catalog, for example, lists only six CP/M disks of games; no business programs, no CAI, no printergraphics, no word/processing, no statistics, no simulations, etc. Yet, in your magazine you have published many such programs and your software arm sells some for other systems. I conclude that nobody should be allowed to steal your products but I have serious doubts about extending this reasoning to protect that which you don't sell. Let me assure you that I am only refering to the programs on machine-readable media, not the documentation; the user should have to buy the publication or your re-print to get that.

I issue you a sincere challenge. I already own all of your back issues. I have many more requirements for software other than games. Much of it you have published in your magazine. I don't intend to enter them all by hand-my machine is supposed to work for me, not the contrary! If you produce what I need, I'll gladly purchase it. If you don't and someone else fills the vacuum by keying it all in and charging a reasonable fee for that service, I think my choice is obvious.

There are no doubt arguments in rebutt of several of the points I have raised. Consider only the main line I am presenting and decide whether it makes sense. You are ideally situated to provide an immeasurable service to the home computerist and perhaps to those of us who are commercially involved as well. I'm sure that if you don't distribute software on as wide a basis as possible that others will step in to fill the gap; it's happening already. This is a diverse and growing industry in which you are one of the leaders. There are profits to be made by all and, providing we don't expect to make them immediately, this hobby/business should advance smoothly for a good number of years. The in-again-out-again quick profit takers will not and should not survive. As a leader in the field, please-for all our sakes-don't fumble the ball now.

M.K. Nunas
V.P. Expansion
Dynamic Info. Tech
224 Gaspe Street
Dieppe, NB, Canada

Response:

Mr. Nunas makes some interesting comments but does not directly address the issue of who actually owns software. (Surely it is not logical that Creative Computing yield the rights to distribute software in any arbitrary format to everyone else when it chooses not to do so itself!) As far as users are concerned, we realize the hardship of having to key in thousands of lines of code, and may decide to release the rights to some of our published software, which we are not interested in selling, to a national CP/M User Group currently under reorganization. SN

(This issue will be discussed further in future Software Legal Forum columns).

Compleat Computer Catalogue

We welcome entries from readers for the "Compleat Computer Catalogue" on any item related, even distantly, to computers. Please include the name of the item, a brief evaluative description, price, and complete source data. If it is an item you obtained over one year ago, please check with the source to make sure it is still available at the quoted price.

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COMPUTERS

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Archives Incorporated, 404 West 35th Street, Davenport, IA 52806. 319/386-7400.

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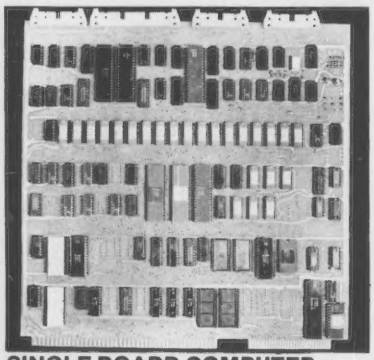

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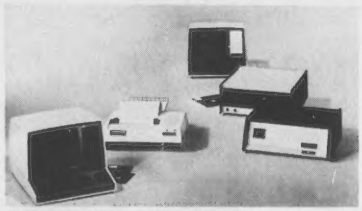

FIVE DATA SYSTEMS PRODUCTS

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Also introduced is the WH14 Line Printer that prints the standard 96-character ASCII set (upper and lower case) on a 5 x 7 dot matrix print head. The microprocessor-controlled WH14 features sprocket feed, adjustable paper width, variable pitch and lines per inch and selectable baud rates from 110 to 4800. $895.

The WH11A is a 16-bit computer is DEC PDP-11/03 compatible with up to 64K bytes of memory and comes complete with power supply and backplane. Its disk operating system supports Basic, Fortran and Assembler languages. $1,895.

The WH27 is the Floppy Disk System designed for use with the H11A. It incorporates a Z80 microprocessor-based controller and has two 8-inch drives with a total capacity of 512K bytes. $2,595.

Zenith Data Systems, Hilltop Road, St. Joseph, MI 49085.

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COMPUTERS

Z-PLUS MICROCOMPUTER SYSTEM

Micromation Incorporated announces the Z-Plus complete microcomputer system. The computer features a Z-80A CPU running at a full 4 MHz, 64k bytes Dynamic RAM memory, 1 megabyte floppy disk storage, complete I/O capabilities for serial and parallel input/output, a constant voltage power supply, and a rack mount enclosure.

The Z-Plus is a three-board computer,incorporating S-100 boards. A Hard Disk Subsystem is also available , providing up to 28 additional megabytes of storage.

The Micromation Z-64 CPU board provides the central processor and 64k bytes of dynamic RAM on a single board, and the Doubler disk controller and two Shugart 8 disk drive provides up to 1 megabyte of reliable floppy disk storage.

The Micromation Complete I/O Board Provides total Input/Output capability, with 2 serial ports and 6 parallel ports, plus optional interface and software drivers for parallel daisy wheel printers. $4295.

Micromation Inc., 1620 Montgomery St, San Fransisco, CA 94111. (415) 398-0289

CIRCLE 210 ON READER SERVICE CARD

QUAY 900

Quay Corporation's desktop microcomputer system, the Quay 900, provides the OEM, business and industrial system designer with a high performance flexible disk based computer, at low cost.

Utilizing Z80-based single board computer, packaged with two quad-density 8000 hour MTBF flexible disks, the Quay 900 features the CP/M disk operating system with prom-resident boot program; an RS232C or 20ma serial port and, a Centronics-compatible line printer interface.

In addition to the application software compatible with CP/M; high-level languages including: Basic, Fortran and Cobol are also available.

The Quay 900 system is priced at less than $4,000.

Quay Corporation, P.O. Box 386, Freehold, NJ 07728. 201/681-8700

CIRCLE 211 ON READER SERVICE CARD

PASCAL COMPUTER SYSTEM

The ACI-90 is an advanced 16-bit Pascal computer system (Microengine equipped) which incorporates up to 2Mbytes of mass storage with two built-in Shugart 8-inch floppy disk drives.

It is said to provide Pascal compiling speeds in excess of 1200 lines a minute and execution enhancements of 4 to 25 times over comparable micro/mini computer implementations.

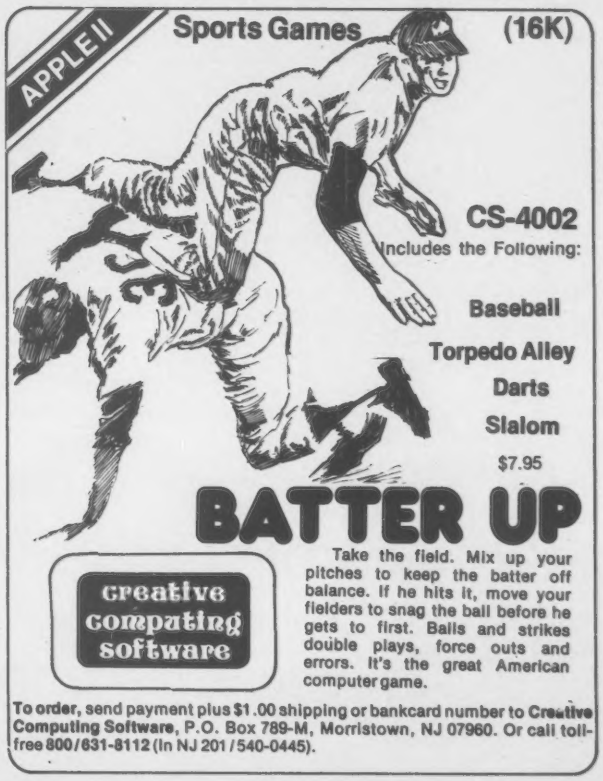
Also included with each system is a complete Professional Business Software Package in Pascal.

The ACI-90 is available in either single or double density operation with either two Shugart 800 single sided or two Shugart 850 double sided floppy disk drives.

The Professional Business Software Package in Pascal contains interactive programs in real-time and accounts receivable/payable, payroll with cost accounting, order entry inventory control and general ledger.

Associated Computer Industries, 17952 Sky Park Circle, Suite A, Irvine CA 92714. (714) 557-0560.

CIRCLE 212 ON READER SERVICE CARD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creative computing software
Take the field. Mix up your pitches to keep the batter off balance. If he hits it, move your fielders to snag the ball before he gets to first. Balls and strikes double plays, force outs and errors. It's the great American computer game.
To order, send payment plus $1.00 shipping or bankcard number to Creative Computing Software, P.O. Box 789-M, Morristown, NJ 07960. Or call toll-free 800/631-8112 (In NJ 201/540-0445).

BOOKS AND BOOKLETS

NASA REPORT

Spinoff 1979, An Annual Report, is a fascinating document published by the National Aeronatics and Space Administration detailing the "spinoff" benefits which stem from NASA's research.

Advances resulting from both the direct application of technology and from the transfer of aerospace technology to other sectors of the economy are described in layman's terms and illustrated wih full color photographs.

According to Spinoff, NASA has been involved in the design of heaters for tennis courts and liquid-cooled garments for victims of rare diseases, modernization of cable cars, drying of water-logged books and the inspiration of an art form along with its better known space shuttle and weather study projets.

The book is divided into three parts: Section 1 summarizes NASA's mainline programs, Section 2 describes spinoff porducts and processes employed in various aspects of everyday life, and Section 3 details the mechanisms of the technology transfer process. The entire document offers an unusual opportunity to feel good about the way one's tax dollars are spent. ——EBS

NASA, P.O.Box 8756, Baltimore -Washington Int'l Airport, MD 21240.

BUSINESS SOFTWARE REPORT

Business Computing Press has published a new report entitled "Evaluating Small Business Software." Directed toward end users, consultants, and systems houses, this 34 page report discusses the general considerations and specific criteria that must be examined when selecting software packages for small business applications.

Specific applications addressed by the report are general ledger, accounts receivable, accounts payable, payroll, and inventory. Evaluation criteria are established that define the required functions, reports, capacity, and supporting information for each application and how they should relate to the needs of a particular business. $15.

BusinessComputing Press, P.O. Box 55056, Valencia, CA, 91355.

CIRCLE 213 ON READER SERVICE CARD

COMPUTER LAW READING LIST

A 16-page reading list, covering 40 periodicals, books and government documents in various areas of computer law is now available from the Computer/Law Journal.

The list was designed to enable lawyers, computer scientists, business persons and students to locate materials on various topical areas of computer law. The list is organized topically under the headings General Publications; Communications; Contracts; Crimes and Security; Electronic Funds Transfer; Evidence; Patents, Copyrights and Trade Secrets; Privacy; and Use of Computers in the Legal Profession.

Single copies of the reading list are available free of charge from Computer/Law Journal, 530 West Sixth Street-10th Floor, Los Angeles, 90014.

CIRCLE 215 ON READER SERVICE CARD

SUPERPASCAL

5-10 times faster... and more!

Meet Pascal/Z,™ the fast, flexible compiler with higher speed, greater efficiency and improved debugging.

- **True Z-80 native code Pascal compiler** — 5-10X faster than competing P-code implementations — *no interpreter required.*
- **The only multi-tasking Pascal** — produces ROMable re-entrant code.
- **Optimized** for fastest execution — recognizes and exploits special cases.
- **Easily transportable** — all hooks to your system made through support library.
- **Includes IEEE standard** floating point package.

Single copy on CP/M-compatible disk includes compiler, companion macro-assembler & source of the library, $275. OEM licenses available. Write or call for more information.

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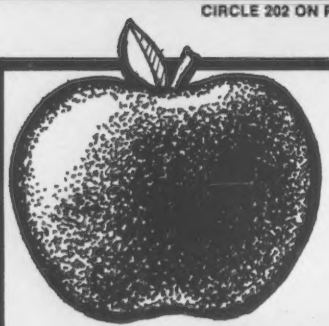

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By: Dann McCreary

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CIRCLE 190 ON READER SERVICE CARD

Apple-Doc

By Roger Wagner

An Aid to the Development and Documentation of Applesoft Programs

This 3 program set is a must to anyone writing or using programs in Applesoft! It not only provides valuable info. on each of your programs, but allows you to change any element throughout the listing almost as easily as you would change a single line!!

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CIRCLE 133 ON READER SERVICE CARD

CHESS * BACKGAMMON * MORE!

TRS-80

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Z-CHESS

PLAY THE CLASSIC GAME OF CHESS USING THE TRS-80 GRAPHICS. SEVEN LEVELS OF DIFFICULTY (UP TO SIX LEVELS OF "LOOK AHEAD") PROVIDE A CHALLENGING GAME FOR ALL. ALPHA-BETA PRUNING AND MOVE SORTING ARE EMPLOYED TO KEEP RESPONSE TIMES TO A MINIMUM. SETUP MODE ALLOWS THE BOARD TO BE ARRANGED AS DESIRED. PLAYS ALL MOVES — INCLUDING CASTLING AND EN PASSANT CAPTURES. NUMBERED SQUARES SIMPLIFY MOVE INPUT. POSSIBLY THE FASTEST GOOD STRATEGY CHESS GAME AVAILABLE!

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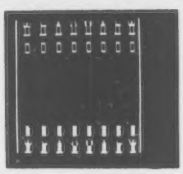
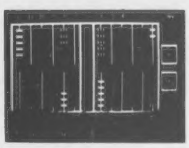


BACK-40



A SUPERIOR OPPONENT WHICH MAKES EXTENSIVE USE OF THE TRS-80 GRAPHICS TO DISPLAY A REGULATION STYLE BACKGAMMON BOARD OF UNRIVALED QUALITY AND CLARITY — INCLUDING THE DICE! BACK-40 DOUBLES IF IT STANDS A GOOD CHANCE OF WINNING — WHICH IT USUALLY DOES! EVERY FEATURE OF A REGULATION BACKGAMMON MATCH IS INCLUDED -- EVEN KEEPS SCORE!

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DR. CHIPS

A FASCINATING PROGRAM BASED ON THE FAMOUS "DOCTOR" AND "ELIZA" PROGRAMS. SIMPLY "TALK" (ER, "TYPE") TO YOUR COMPUTER — DR. CHIPS WILL ANALYZE YOUR SENTENCES AND "TALK" BACK TO YOU — IMMEDIATELY! ALTHOUGH DR. CHIPS' RESPONSES SHOULD NOT BE TAKEN SERIOUSLY, HE IS THE ULTIMATE COMPUTER INTRODUCTION FOR THE FAMILY AND FRIENDS — AND A SUPER "CONVERSATIONALIST" AT PARTIES!

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CIRCLE 131 ON READER SERVICE CARD

SIMUTEK PRESENTS

★ TRS-80 ★

.....GAMES.....

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★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE ONE ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

GRAPHIC-TREK "2000" — This full graphics, real time game is full of fast, exciting action! Exploding photon torpedoes and phasers fill the screen! You must actually navigate the enterprise to dock with the giant space stations as well as to avoid klingon torpedoes! Has shields, galactic memory readout, damage reports, long range sensors, etc! Has 3 levels for beginning, average, or expert players! ★ **INVASION WORG** — Time: 3099, Place: Earth's Solar System Mission: As general of Earth's forces, your job is to stop the Worg invasion and destroy their outposts on Mars, Venus, Saturn, Neptune, etc! Earth's Forces: Androids — Space Fighters — Lazer Cannon — Neutrino Blasters! Worg Forces: Robots — Saucers — Disintegrators — Proton Destroyers! Multi level game lets you advance to a more complicated game as you get better! ★ **STAR WARS** — Manuever your space fighter deep into the nucleus of the Death Star! Drop your bomb, then escape via the only exit. This graphics game is really fun! May the Force be with you! ★ **SPACE TARGET** — Shoot at enemy Ships with your missiles. If they eject in a parachute, capture them — or if you're cruel, destroy them! Full graphics, real time game! ★ **SAUCERS** — This fast action graphics game has a time limit! Can you be the commander to win the distinguished cross! Requires split second timing to win! Watch out!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE TWO ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

CHECKERS 2.1 — Finally! A checkers program that will challenge everyone! Expert as well as amateur! Uses 3-ply tree search to find best possible move. Picks randomly between equal moves to assure you of never having identical games. ★ **POKER FACE** — The computer uses psychology as well as logic to try and beat you at poker. Cards are displayed using TRS-80's full graphics. Computer raises, calls, and sometimes even folds! Great practice for your Saturday night poker match! (Plays 5 card draw). ★ **PSYCHIC** — Tell the computer a little about yourself and he'll predict things about you, you won't believe! A real mind bender! Great amusement for parties. ★ **TANGLE MANIA** — Try and force your opponent into an immobile position. But watch out, they're doing the same to you! This graphics game is for 2 people and has been used to end stupid arguments. (And occasionally starts them!) ★ **WORD SCRAMBLE** — This game is for two or more people. One person inputs a word to the computer while the others look away. The computer scrambles the word, then keeps track of wrong guesses.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE THREE ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

POETRY — This program lets you choose the subject as well as the mood of the poem you want. You give TRS-80 certain nouns or names, then the mood, and it does the rest! It has a 1000-word + vocabulary of nouns, verbs, adjectives and adverbs! ★ **ELECTRIC ARTIST** — Manual: draw, erase, move as well as, Auto: draw, erase and move. Uses graphics bits not bytes. Saves drawing on tape or disk! ★ **GALACTIC BATTLE** — The Swineus enemy have long range phasers but cannot travel at warp speed! You can, but only have short range phasers! Can you blitzkrieg the enemy without getting destroyed! Full graphics — real time! ★ **WORD MANIA** — Can you guess the computer's words using your human intuitive and logical abilities? You'll need to, to beat the computer! ★ **AIR COMMAND** — Battle the Kamikaze pilots. Requires split second timing. This is a FAST action arcade game.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE FOUR ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LIFE — This Z-80 machine language program uses full graphics! Over 100 generations per minute make it truly animated! You make your starting pattern, the computer does the rest! Program can be stopped and changes made! Watch it grow! ★ **SPACE LANDER** — This full graphics simulator lets you pick what planet, asteroid or moon you wish to land on! Has 3 skill levels that make it fun for everyone. ★ **GREED II** — Multi-level game is fun and challenging! Beat the computer at this dice game using your knowledge of odds and luck! Computer keeps track of his winnings and yours. Quick fast action. This game is not easy! ★ **THE PHARAOH** — Rule the ancient city of Alexandria! Buy or sell land. Keep your people from revolting! Stop the rampaging rats. Requires a true political personality to become good! ★ **ROBOT HUNTER** — A group of renegade robots have escaped and are spotted in an old ghost town on Mars! Your job as "Robot Hunter" is to destroy the pirate machines before they kill any more settlers! Exciting! Challenging! Full graphics!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE FIVE ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

SUPER HORSERACE — Make your bets just like at the real racetrack! 8 horses race in this spectacular graphic display! Up to 9 people can play! Uses real odds but has that element of chance you see in real life! Keeps track of everyone's winnings and losses. This is one of the few computer simulations that can actually get a room of people cheering! ★ **MAZE MOUSE** — The mouse with a mind! The computer generates random mazes of whatever size you specify, then searches for a way out! The second time, he'll always go fastest route! A true display of artificial intelligence! Full graphics, mazes & mouses! ★ **AMOEBA KILLER** — You command a one man submarine that has been shrunken to the size of bacteria in this exciting graphic adventure! Injected into the president's bloodstream, your mission is to destroy the deadly amoeba infection ravaging his body! ★ **LOGIC** — This popular game is based on Mastermind but utilizes tactics that make it more exciting and challenging — has 2 levels of play to make it fun for everyone. ★ **SUBMARINER** — Shoot torpedoes at the enemy ships to get points. Fast action graphics, arcade type game is exciting and fun for everybody!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ PACKAGE SIX ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

20 HOME FINANCIAL PROGRAMS — Figures amortization, annuities, depreciation rates, interest tables, earned interest on savings and much, much more. These programs will get used again and again. A must for the conscientious, inflation minded person.

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BACKGAMMON 5.0 — 2 different skill levels make this game a challenge to average or advanced players. (Not recommended for beginners). Looks for best possible move to beat you! FANTASTIC GRAPHICS. Plays doubles and uses international rules. ★ **SPEED READING** — Increases your reading speed. Also checks for comprehension of material. Great for teenagers and adults to improve reading skills. ★ **PT 109** — Drop depth charges on moving subs. Lower depths get higher points in this fast action graphics game. ★ **YAHTZEE** — Play Yahtzee with the computer. This popular game is even more fun and challenging against a TRS-80! ★ **WALL STREET** — Can you turn your $50,000 into a million dollars? That's the object of this great game. Simulates an actual stock market!

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CIRCLE 187 ON READER SERVICE CARD

WORD PROCESSING

WORD PROCESSING SYSTEM

Alpha Micro announces the release of a new word processing system consisting of two components: AlphaVUE, a high speed, two-dimensional editor, capable of editing large files by displaying one page at a time, and TXTFMT, used in conjunction with AlphaVUE to produce formatted documents.

Word processing features include: screen-oriented, two-dimensional editor, automatic page numbering, automatic table of contents and index production, automatic backup file protection, high processing speed, and left/right justification.

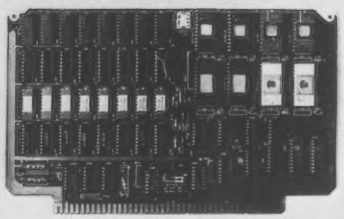
The system hardware requirements are an Alpha Micro AM 100 based computer system and a CRT with direct cursor addressing and erase-to-end-of-line capability.

The word processing system is available as a standard feature of all Alpha Micro computers systems at no additional cost.

Alpha Micro, 17881 Sky Park North, Irvine, CA 92714. (714) 957-1404.

CIRCLE 216 ON READER SERVICE CARD

MEMORY



6800 SINGLE BOARD MEMORY SYSTEM

Phoenix Digital Corporation introduces a single card 16K RAM + 32K EPROM and /or ROM Memory Board, the PCM 16-32 Memory Board System.

The PCM 16-32 is compatible with M6800, 6802, 6801, 6809 and 650X series microcomputers and replaces 2 or more cards in the Motorola Exorciser and Exorterm type products.

Industrial and commercial temperature versions are available for a variety of environmental applications. $450.

Phoenix Digital Corporation, 3027 N. 33rd Dr., Phoenix, AZ 85017, (602) 278-3591.

CIRCLE 217 ON READER SERVICE CARD

VENDOR LITERATURE

COMPUTERS IN EDUCATION

Creative Publications has released a full-color newsletter/catalog of computers in education which includes a feature story, two classroom computer activities, and a series of products selected with an emphasis on education.

The firm has also announced plans to publish educational computer materials, and to conduct computer workshops at its Creative Teaching Center in Mountain View, California.

Creative Publications, P.O. Box 10328, Palo Alto, CA 94303. (415) 968-1101.

CIRCLE 218 ON READER SERVICE CARD

COMPUTER BOOK CATALOG

A new catalog featuring computer and computer-related titles has been released by Howard W. Sams.

Organized into five areas--Basics, Programming, Computer Technology, Reference and Computer-Related--the catalog lists books that are directed to wide range of people and interests, from the home hobbyist to the technically-oriented professional.

Howard W. Sams & Co., Inc., 4300 W. 62nd Street, P.O. Bos 558, Indianapolis, IN 46206.

CIRCLE 219 ON READER SERVICE CARD

CP/M 2.0

TRS-80 MOD II

Expand the horizons of your TRS-80 model II with the industry standard operating system, CP/M version 2.0, and get these advantages over TRSDOS:

- compatible with hundreds of **existing** software packages
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- assembler, editor, file handler, and dynamic debugger **included** with the operating system

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CP/M is a trademark of Digital Research Inc. TRS-80 is a trademark of Tandy Corp.

CIRCLE 184 ON READER SERVICE CARD

Computer Design Labs

Z80® Disk Software

We have acquired the rights to all TDL software (& hardware). TDL software has long had the reputation of being the best in the industry. Computer Design Labs will continue to maintain, evolve and add to this superior line of quality software.
— Carl Galletti and Roger Amidon, owners.

All of the software below is available on any of the following media for operation with a Z80 CPU using the CP/M® or similar type disk operating system (such as our own TPM*).

for TRS-80® CP/M (Model One)
for 8" CP/M (soft sectored single density)
for 5¼" CP/M (soft sectored single density)
for 5¼" North Star CP/M (single density)
for 5¼" North Star CP/M (double density)

BASIC I

A powerful and fast Z80 Basic interpreter with EDIT, RENUMBER, TRACE, PRINT USING, assembly language subroutine CALL, LOADGO for "chaining", COPY to move text, EXCHANGE, KILL, LINE INPUT, error intercept, sequential file handling in both ASCII and binary formats, and much, much more. It runs in a little over 12 K and is ROMable. An excellent choice for games since the precision was limited to 7 digits in order to make it one of the fastest around. $99.95.

BASIC II

Basic I but with 12 digit precision to make its power available to the business world with only a slight sacrifice in speed. Still runs faster than most other Basics (even those with much less precision). $99.95.

BUSINESS BASIC

The most powerful Basic for business applications. It adds to Basic II with random or sequential disk files in either fixed or variable record lengths, simultaneous access to multiple disk files, PRIVACY command to prohibit user access to source code, global editing, added math functions, and disk file maintenance capability without leaving Basic (list, rename, or delete). $159.95.

ZEDIT

A character oriented text editor with 26 commands and "macro" capability for stringing multiple commands together. Included are bidirectional search with optional replace and a complete array of character move, add, delete, and display functions. $49.95.

ZTEL

Z80 Text Editing Language - Not just a text editor. Actually a language which allows you to edit text and also write, save, and recall programs which manipulate text. Commands include conditional branching, subroutine calls, iteration, block move, expression evaluation, and much more. Contains 36 value registers and 10 text registers. Be creative! Manipulate text with commands you write using Ztel. $68.95.

TOP

A Z80 Text Output Processor which will do text formatting for manuals, documents, and other word processing jobs. Works with any text editor. Does justification, page numbering and headings, spacing, centering, and much more! $68.95.

MACRO I

A macro assembler which will generate relocatable or absolute code for the 8080 or Z80 using standard Intel mnemonics plus TDL/Z80 extensions. Functions include 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical operations, local and global symbols, chaining files, linking capability with optional linker, and recursive / reiterative macros. This assembler is so powerful you'll think it is doing all the work for you. It actually makes assembly language programming much less of an effort and more creative. $49.95.

MACRO II

Expands upon Macro I's linking capability (which is useful but somewhat limited) thereby being able to take full advantage of the optional Linker. Also a time and date function has been added and the listing capability improved. $68.95.

LINKER

How many times have you written the same subroutine in each new program? Top notch professional programmers compile a library of these subroutines and use a Linker to tie them together at assembly time. Development time is thus drastically reduced and becomes comparable to writing in a high level language but with all the speed of assembly language. So, get the new CDL Linker and start writing programs in a fraction of the time it took before. Linker is compatible with Macro I & II as well as TDL/Xitan assemblers version 2.0 or later. $68.95.

DEBUG I

Many programmers give up on writing in assembly language even though they know their programs would be faster and more powerful. To them assembly language seems difficult to understand and follow, as well as being a nightmare to debug. Well, not with proper tools like Debug I. With Debug I you can easily follow the flow of any Z80 or 8080 program. Trace the program one step at a time or 10 steps or whatever you like. At each step you will be able to see the instruction executed and what it did. If desired, modifications can then be made before continuing. It's all under your control. You can even skip displaying a subroutine call and up to seven breakpoints can be set during execution. Use of Debug I can pay for itself many times over by saving you valuable debugging time. $69.95.

DEBUG II

This is an expanded debugger which has all of the features of Debug I plus many more. You can "trap" (i.e. trace a program until a set of register, flag, and/or memory conditions occur). Also, instructions may be entered and executed immediately. This makes it easy to learn new instructions by examining registers/memory before and after. And a RADIX function allows changing between ASCII, binary, decimal, hex, octal, signed decimal, or split octal. All these features and more add up to give you a very powerful development tool. Both Debug I and II must run on a Z80 but will debug both Z80 and 8080 code. $88.95.

ZAPPLE

A Z80 executive and debug monitor. Capable of search, ASCII put and display, read and write to I/O ports, hex math, breakpoint, execute, move, fill, display, read and write in Intel or vinary format tape, and more! Disk $19.95. Also available in 2Kx8 ROM with initialization for the SMB I or II (3 ACIA's and 1 PIA) $34.95.

SMB II bare board $49.95.
One PIA and four 74LS244's for SMB II $12.95

8080 version of Zapple - disk $19.95 on 2516 $49.95.

TPM*

A NEW Z80 disk operation system! This is not CP/M*. It's better! You can still run any program which runs with CP/M* but unlike CP/M* this operating system was written specifically for the Z80* and takes full advantage of its extra powerful instruction set. In other words its not warmed over 8080 code! Available for TRS-80®, Tarbell, ICOM, Xitan DDDC, SD Sales "VERSA-FLOPPY", North Star (SD&DD), and Digital (Micro) Systems. $49.95.

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The Osborne package. Requires C Basic 2 2 disks $74.95 Book $15.00

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Required for Osborene software $99.95 Manual included.

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For Phone orders only call toll free
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Computer Design Labs
342 Columbus Avenue
Trenton, N.J. 08629
Dealer inquiries invited.

*TPM is a trademark of Computer Design Labs. It is not CP/M. *CP/M is a trademark of Digital Research

For tech calls: United Software Applications 609-599-2146 or Ohio Electronics 609-448-5105

CIRCLE 194 ON READER SERVICE CARD

DISK SYSTEMS

90-MEGABYTE DISK SUBSYSTEM

Alpha Micro has announced the additon of the model AM 410, an S-100 bus compatible 90-megabyte disk subsystem based on the CDC "Phoenix" drive tied to a dual-board controller and interconnecting cables.

Up to four drives can be connected to one controller for a total storage capacity of 360 million bytes of data. Although the AM 410 was designed to work with Alpha Micro's AMOS operating system, it may be used with other operating systems on either the 8 or the 16-bit S-100 bus.

Alpha Micro, 17881 Sky Park North, Irvine, CA 92714. 714-957-1404.

CIRCLE 220 ON READER SERVICE CARD

PERIPHERALS

GRAPHICS DISPLAY

Objective Design announces the G-Box, a peripheral device which can be used with any computer to add high density graphics. The video image output by the G-Box is a matrix of 512x240 dot positions with the capability of expansion using larger memories.

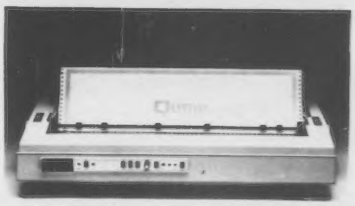
Connection to a host computer is via an RS-232 serial link and interfaces for joysticks, serial and parallel ports, a light pen interface, and other options are built into the G-Box.

Versions of the G-Box can be adapted through use of different connectors to work with any type of computer including S-100, TRS-80, Heath, Commodore, North Star, minicomputers, and others.

Objective Design, Inc., P.O. Box 20325, Tallahassee, FL 32304. (904) 224-5545.

CIRCLE 221 ON READER SERVICE CARD

TERMINALS & I/O



INTELLIGENT WIDE-CARRIAGE PRINTER

Qume Corporation has introduced the Sprint 5 WideTrack printer.

An industry-standard RS-232-C interface and internal programming allow the Sprint 5 WideTrack printer to offer all of the capabilities of the Qume Sprint 5 RO (receive only) smart terminal. It combines a 264-column printing area and 40-character-per-second speed. $3,995.

Qume Corporation, 2350 Qume Dr., P.O. Box 50039, San Jose, CA 95150. (408)942-4000.

CIRCLE 222 ON READER SERVICE CARD

TRS-80 SOFTWARE

PACKER: Automatically edits all or part of your Basic program to ease editing, run faster,or save memory. Has 5 sections: 1. UNPACK — unpacks multiple state Basic program lines into single statements maintaining program logic. Also inserts spaces and renumbers lines for easier editing. 2. SHORT — shortens your Basic program by editing out all REM statements, unnecessary words and spaces. 3. PACK — executes UNPACK and SHORT, then packs lines into multiple statement lines. Maintains program logic. 4. RENUM — renumbers program lines including all GOTO's, etc. You specify increment. 5. MOVE — moves any line or block of lines to any new location in the program and renumbers lines. Written in machine language, supplied on tape in 3 versions for 16K, 32K, and 48K systems. Works under Level II and Disk Basic. $29.95

DISASSEMBLER: Read, write, and copy system tapes. Display and modify memory contents. Disassemble ROM, DOS, and system tapes into Z80 Mnemonics. Search for strings in memory. Much more!! Includes 32 pages of documentation and other information. For 16K Level II $19.95

SYSTEM TAPE DUPLICATOR: Copy your system format tapes. Includes verify routine. For any Level II $12.95

MICROSOFT FORTRAN: includes Fortran compiler, loader, editor, and library of scientific functions. For 32K Level II and 1 Disk $90.00

MICROSOFT ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM: includes EDIT-80 Text Editor, MACRO-80 Assembler, CREF-80 Cross Reference facility, and LINK-80 Linking Loader. For 32K Level II and 1 Disk $90.00

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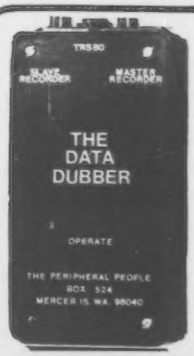
CIRCLE 200 ON READER SERVICE CARD

PROCESSOR TECHNOLOGY Sol, Cuts, or Helios owners: **PROTEUS** is your user's association, established 1977. Software, bimonthly journal, discounts, hardware updates, etc. Dues for 1980: $18 in U.S., Canada, or Mexico; otherwise U.S. $26. Send $1 for sample issue. Proteus, 1690 Woodside Road, Suite 219, Redwood City, CA 94061.

CIRCLE 185 ON READER SERVICE CARD

The "DATA DUBBER"

DUPLICATES ANY PROGRAM TAPE **TRS-80**



Yes, even those in machine language! Feed your cassette into the "Data Dubber" and get out exact replicas of the TRS-80 CSAVE data pulses. Obtain perfect CLOAD's even from tapes with hum, distortion, or minor dropouts . . . and without constantly adjusting the volume. Connect a second cassette to the "Data Dubber" and make perfect reproductions, just as if the data had come from the TRS-80.

The "Dubber" works with Level I or II and costs only **$49.95** postage paid. Start your own software business. Pays for itself in time saved and reduced tape cost. Order the "Data Dubber" today! If you are not completely satisfied with its performance simply return it for full refund.

P.O. Box 524-CC

THE PERIPHERAL PEOPLE PO Box 524, Mercer Island, WA 98040

CIRCLE 183 ON READER SERVICE CARD

MISCELLANEOUS

LIE DETECTOR MONITORS THE VOICE

The Truth Machine is a new microcomputer that pinpoints deception by analyzing inaudible microtremors in the human voice.

A digital display indicates stress in the speaker's voice. $149.

Telestar, Inc., 200 South Front St., Wormleysburg, PA 17043. (717)763-7882.

CIRCLE 223 ON READER SERVICE CARD

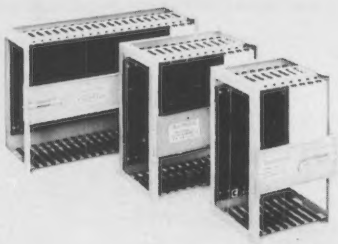
FORMS CADDIES

To facilitate the handling of forms on the printer, Computer Resources has introduced two new rolling forms caddies which are said to reduce printer downtime, simplify and speed forms changeover.

Model 1114 has inside dimensions of 12¼" x 15¾". $46.50. Model 914 is 9" x 15¾". $42.25.

Computer Resources Company of New York, Suite 1500, 2 Penn Plaza, New York, NY 10001, (800) 523-9350.

CIRCLE 224 ON READER SERVICE CARD



CARD CAGES

Cromemco introduces three new, S-100 bus, card cages. The cages are available in 8-slot (10-7/8" wide x 7" long x 6-5/8" high), 12-slot (10-7/8" wide x 10-1/4" long x 6-5/8" high) or 21-slot (10-7/8" wide x 16-3/4" long x 6-5/8" high) versions.

The back planes include a full set of edge connectors wave-soldered in place on Cromemco's Blitz Bus.

The 8-slot card cage (Model CC-8) is available for $195; the 12-slot card cage (Model CC-12), for $245; and the 21-slot card cage (Model CC-21), for $395.

Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94043. (415) 964-7400.

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This system in strictly for the market speculator. Working with price, calculated volatility, and calculated average daily premium, this system picks the best buys from 75 or more options. Judgement by the analyst is required. For $35.00 you receive two programs plus example data base and instruction manual. TRS 80 LEVEL II and PET

STOCK MARKET ANALYSIS SYSTEM

Technical analysis, 12 daily and 15 weekly indicators, for the stock market enthusiast. This system signaled the Oct. 78 debacle. For $25.00 you receive two programs plus data base and 27 page detailed instruction manual.
TRS 80 LEVEL I or II 16K and PET

FINANCIAL ANALYSIS SYSTEM

Includes two programs and hard copy instructions for better control of your stock and option transaction. For $20.00 you receive software with eight analysis routines. Two of these routines are stock transactions which made money and option transactions which made money. Six more program routines exist with some consideration given to taxes. Please indicate:
TRS 80 LEVEL II 16K or PET 8K

ACCOUNTING ANALYSIS SYSTEM

Includes two programs and hard copy instructions for a small cash enterprise. From your data base a Profit and Loss Statement as well as a Balance Sheet are produced. In addition simple budget comparisons are made. Please remit $20.00 and indicate:
TRS 80 LEVEL II 16K or PET 8K

LETTER PROCESSER

This program for TRS 80 owners with printers. Generates letters to different individuals with the same body. Cassette file stores names and addresses. Remit $15.00.

Distributed by: STEVEN E. SHAW, P.E.
P.O. Box 1707
Tampa, Florida 33601

CIRCLE 108 ON READER SERVICE CARD

NEWSLETTER

REPORT ON "TELETEXT"

The Institute for the Future is a non-profit corporation dedicated to systematic and comprehensive studies of the long-range future. A recent special issue of its Newsletter is devoted to reporting on a workshop held in June 1979 to identify issues associated with the introduction of teletext and videotext in the U.S.

"Teletext," explain the editors, "is a generic term for the broadcast of text and graphics as part of a television signal. Video text...(is) the term for the generic class of services that provides transmission on an interactive basis, typically through a telephone connection between a television and a computer."

Copies of the publication are available from the Institute without charge.

Institute for the Future, 2740 Sand Hill Rd., Menlo Park, CA 94025. (415) 854-6322.

CIRCLE 226 ON READER SERVICE CARD

SOFTWARE

FANTASY ADVENTURE

The Datestones of Ryn is a solo fantasy adventure from Automated Simulations. Another in the Dunjonquest series, the Datestones of Ryn is Microquest number 1 - a dark and deadly labyrinth of caves and tunnels where Rex has hidden the date stones stolen from the ducal calendar of Ryn.

The player competes against friends, family or himself in a race against time to see who can rescue the stones before Time itself stops.

The Datestones of Ryn is available for the PET with 16K RAM and cassette drive and for the TRS-80, Level II, 16K, with cassette or disk. $14.95.

Automated Simulations, P.O. Box 4232, Mountain View, CA, 94040.

CIRCLE 227 ON READER SERVICE CARD

TAX PREPARATION PROGRAM

Microtax is a set of programs from Computer Strategies. The basic input program prompts the tax consultant with the exact wording of each line from the federal forms. It branches from the 1040 form to take the dividends and exclusions, and again for itemized deductions.

It asks the minimum of questions to generate income averaging and offers the consultant the choice of averaging or continuing with the regular tax computation. State forms and other federal forms require answering only a few more questions.

At any time, any figure can be changed to see the effect of such change on the total tax picture, or to correct typing mistakes. Unnecessary questions can be skipped.

North Star Doc

DOCUMENTATION
- Prints formatted program listings (user selected spacing, titling, dating, and automatic paging)
- Prints cross reference table of all program variables
- Prints cross reference table of all 'GOTO' type statments

OPTIMIZATION
- Concatenates short lines into multiple statement lines of user selected length (Max=255 chars/line)

SPEED
- Faster execution of 'GOTO' type statements (up to 75% reduction in the number of lines of coding allows basic to locate the destination of a 'GOTO' type statement faster)
- Fast effecient subroutine to implement 'GOTO N' type statement

SIZE
- Typically reduces program size by 35%
- Removes all blanks not enclosed in quotes
- Optionally removes all REM statements except thoe that are the target of a 'GOTO' type statement
- Saves three bytes for every statement concatenated

CONFIDENTIALITY
- Optionally inhibits the correct functioning of the North Star Basic 'list' and 'edit' commands if the user specified line length exceeds 132 chars/line

DOC runs on release 4 or 5 of North Star Basic, single or double density drives. Minimum of 32K memory required. $59.00 price includes diskette and instructional manual. Order your copy from:

Mini Business Systems
P.O. Box 15587
Salt Lake City, Utah 84115
PH: (801) 467-1571

CIRCLE 129 ON READER SERVICE CARD

MICRO MART

16K UPGRADE KIT FOR TRS-80, APPLE, PET, SORCERER $70 Mostek 4215-3 200ns 16K x 1 RAMs

MICROPOLIS 8" HARD DISK DRIVE with Power, S-100 controller
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CIRCLE 173 ON READER SERVICE CARD

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One or more drives. Order entry calculates sales tax, shipping, amount for multiple items. Credit checking, aging, sales analysis, invoices, statements and reports. As opposed to most other A/R, ours can be used by doctors, store managers, etc. MOD-II version $149

WORD PROCESSOR 16K $39, 32K $49, MOD-II $49.
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All programs are on-line, interactive, random access, virtually bug free, documented and delivered on disks. MOD-I requires 32K DOS. We challenge all software vendors to offer low cost manuals so you can compare and avoid those high-priced undocumented, 'on-memory programs. Send $5 for a MOD-I manual and $10 for MOD-II.

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Anadex Printer	995	875
Florida Data Printer 600 CPS	4300	Call for Price
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Textwriter III		125
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CIRCLE 107 ON READER SERVICE CARD

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Give any command from the keyboard as well as in file
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Change pitch in mid-line, even mid-word
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Any command may be conditional
Print to disk and/or printer
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Switch from specialty printer to CP/M list device
Print the same file on either specialty or standard printer

EASE OF OPERATION

With all its power, the MAGIC WAND is remarkably easy to use. This is no accident. The command structure is designed to be flexible and logical so that you can perform basic functions with a minimum of commands.

We have included in the manual a step-by-step instructional program, for the person who has never used a word-processor before. The trainee uses sample files from the system disk and compares his work to simulated screens and printouts.

In addition to the lessons, the manual has a complete documentation of the command structure, special notes for programmers, an introduction to CP/M for non-programmers and a glossary. The manual is typeset, rather than typewritten, for greater legibility.

We have written the manual in non-technical English, because we want you to read it. We don't overload you with a bunch of jargon that could confuse even a PhD in Computer Sciences.

We send out newsletters so that users of the MAGIC WAND can learn special applications of the print commands. For example, we might show you how to create a mailing list or set up an index for a file.

In short, we've done everything we can to make things easy for you. Because the best software in the world is just a bunch of code if you can't use it.

For more information, call or write:

small business applications, inc.

3220 Louisiana • Suite 205 • Houston, Texas 77006 • 713-528-5158

CP/M is a registered trademark of Digital Research Corp

CIRCLE 201 ON READER SERVICE CARD

SOFTWARE

The client file is saved for "batch" print-out at a later time or can be printed immediately.

Computer Strategies, Inc., 300 N. Main Street (Hillcrest Professional Bldg.), Spring Valley, NY 10977. · (914) 356-7770.

CIRCLE 228 ON READER SERVICE CARD

EDUCATIONAL

Reading Comprehension: What's Different? for the PET is a set of ten programs which present logical problems where the student picks the one word in four which does not belong. In **Minicrossword** for Apple or TRS-80 the computer makes a crossword puzzle from its word list. **Word Skills 1**—Prefixes for the PET presents common prefixes and the words in which they appear. Program Design, Inc., 11 Idar Ct., Greenwich, CT 06830. (203) 661-8799.

CIRCLE 229 ON READER SERVICE CARD

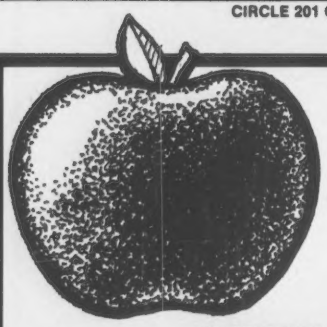
AMCT-80 (Automated **Morse Code Teacher**) is a program for the TRS-80 which is designed to teach and build proficiency in receiving Morse code. $14.95. Cost Effective Computer Services, 728 S. 10th St., Suite #2, Grand Junction, CO 81501.

CIRCLE 230 ON READER SERVICE CARD

The **Visual Instructional Computer** uses the TRS-80 display to teach basic computer architecture plus assembly and machine languages to the casual or beginning student. The Carta Lesson Library is a three-part package of study and test material with the capability of asking questions in a variety of formats and in timed test sequences. Carta Associates, Inc., Education Products Division, 640 Lancaster Ave., Frazer, PA 19355.

CIRCLE 231 ON READER SERVICE CARD

Among the educational programs available for the TRS-80 in Level I are:



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By: Dann McCreary

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the master's voice

Hugh B. Brous, Jr.

"The technique is quite simple, General," Parker said trying to display a patience he didn't feel. Some times high moguls have to be treated almost like children, he thought. And this bemedalled hero had been inexcusably late and had missed the formal briefing with all his beautiful charts and slides. In the background he could hear the jet fighter with the test equipment screaming down the runway for takeoff.

"The idea came to me one day some time ago as I stood on this apron and listened to that speaker over there," he said and nodded in the direction of a pole mounted speaker spilling the chatter of tower and pilots. "We were running tests on heat seeking missiles, and we could hear the pilot as he watched his bird racing toward the target drone. 'Up a little,' he said. 'More to the left, not too much - steady - steady,' and so forth. So the thought came to me, suppose the target was not a heat source, or was not resolvable on a radar scope, what then? Thus the concept of Project Talk was born."

"An ingenious idea," the general said.

"It was pure genius," Parker admitted with his usual modesty. "The toughest problem was getting DOD's approval and financing. And you have no idea of what all I had to do to get the right staff for this project. Especially, Dr. Meier."

"I'm well aware of all of that," the general said.

Parker ignored the general's scowl of disapproval and continued. "The system works like this," he said beginning to sketch a flow chart in the air with his forefinger. "After the pilot has released his missile he observes its course and speaks the desired course corrections into his mike. A small onboard computer/translator, that was Dr. Meier's magnificent work, converts his speech into appropriate digital signals, which are then transmitted to the missile. Now, here, aboard the missile the signals are received, passed through digital to analog converters, then through amplifiers to the controlling servos that make the corrective thrust adjustments."

The general nodded as if he understood, then wandered over to join the rest of the VIP observers, shaking his head as if he didn't.

Parker joined his staff heads who were waiting for him by the microphone in front of the assembled guests and observers.

"Ladies and gentlemen," he began officiously, "you are about to witness a degree of control in firing accuracy dreamed of by man since the invention of the spear. With the techniques developed by Project Talk our pilots will be able to talk a missile through the bung hole of the proverbial pickle barrel."

A few condescending smiles met Parker's attempt at humor.

"Far out over there across the runway you can see our black plywood and tar paper shack which is the first of today's ground targets."

"Turning onto approach track," the speaker crackled.

"Roger," from the tower.

"Our pilot will fire his missile on a path far to the right of the target and with a climbing attitude. He will then . . ."

"Coming up to firing point."

". . . put it directly onto the target with a few simple verbal commands."

"Test one released."

"Roger, and tracking."

High overhead a small black speck with a furious tail of fire and smoke darted upward for the heavens.

"Down a little, left a little," came from the speaker.

"Now ladies and gentlemen," Parker beamed confidently, "prepare yourselves for a miracle."

"Down, down - left left - DOWN. DOWN!" came from the speaker.

The black speck continued onward, upward. Its fire went out, it coasted to its peak, then began a long glide toward the hills in the distance.

"LEFT. HARD LEFT!" the speaker yelled. "MAKE A DAMN U-TURN IF YOU CAN, YOU STINKING . . ."

The last part of the pilot's command was lost in a sputter of static.

The missile ignored the verbal commands and continued its gentle glide, terminating it on a distant hillside with a beautiful orange flash and a lovely puff of smoke.

Disgustedly from the speaker, "Now I think I'll go buzz that damn shack and knock it down with my landing gear."

"Negative. Repeat, negative," from the tower.

Behind him Parker heard a few snickers and harumphs as the VIP's shuffled off the platform and back to the headquarters building. His face turned red and his neck started to swell as he turned to his staff.

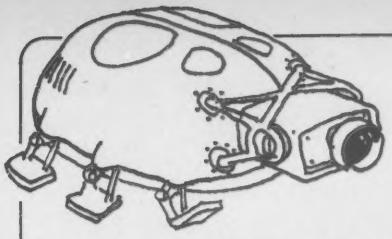
"All right, who screwed up?"

They all started at once, each vowing that his particular module of the equipment had been thoroughly and personally tested, both before installation and after, and thoroughly again just before takeoff, and that the only piece of gear in the entire lash-up that was not a simple adaptation of standard off the shelf hardware was the verbal translator, and that . . .

Parker felt faint and looked for a seat when he heard Dr. Meier enter the argument.

"Chust ein minute, chentlemens. I mineself checked der tranzlator mit mein own vorts, und it vas . . . " ⊡

Hugh B. Brous, Jr., 22427 Statler Blvd., St. Clair Shores, MI 48081



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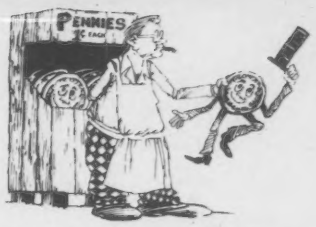

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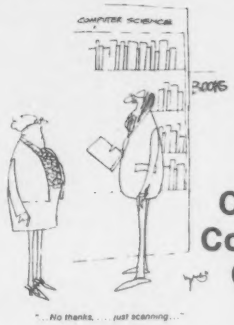

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This unique book by Ruth Leavitt covers the latest techniques in computer art, animation and sculpture. In its pages 35 artists explain how they use computers as a new means of self-expression. **The San Francisco Review of Books** said "Get yourself a copy of this book if you enjoy feeding your mind a diet of tantalizing high-impact information." Over 160 illustrations, some in full color. 121 pages hardbound [6E] $10.00. Softbound [6D] $4.95.

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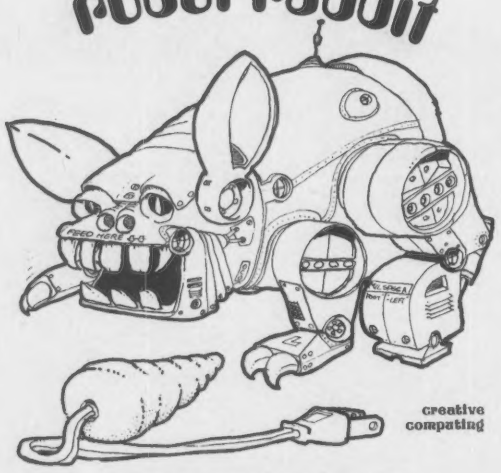
robot rabbit



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Reviews

Stephen B. Gray

Free-Lance Software Publishing, by Benjamin J. Kern. Kern Publications, Box H211, Littleton, MA 01460. 106 pages, paperback $10. 1979.

"Many independent software writers are making a good deal of money selling their own programs," says the information sheet accompanying this book, which drops names such as Adam Osborne, Michael Shrayer and Joe Cullinane.

Adam Osborne is said to sell more than 1000 copies of **Payroll and Cost Accounting** every month; Michael Shrayer "wrote a program for personal computers that does word processing. He sells it through computer stores for $175 a copy;" and Joe Cullinane "started in 1968 with a program called CULPRIT; a simple information retrieval system. Today, Joe is president of the . . . Cullinane Corp., with gross annual sales in 1979 of $8,920,545 and *net profit* of $1,043,810."

The foreword says "there are three unique aspects to free-lance software publishing that make it an ideal business for the individual: (1) You can do it either full-time or part-time as an adjunct to regular employment. (2) It requires little capital investment compared to other business with similar profit potential. (3) The potential profits are practically limitless."

Dr. Kern provides a lot of practical information, starting with "Direct Sale of Major Software," in which he discusses advertising, sales presentations, running a benchmark, negotiating a contract, etc. He goes into details such as the advantage of making a sales call in the early afternoon, and the best people to reach.

Later chapters look at selling through a service bureau, leasing private tapes, selling through intermediaries such as consulting firms, selling software in book form, pricing software, the user's manual, software theft, business structure, etc.

A dozen case studies describe programs written by a graduate student from Belmont, Mass., who "has a set of subroutines that perform matrix operations very efficiently. He charges $15,000." Eleven success stories are balanced by one "of an individual who failed trying to computerize the real-estate business in eastern Massachusetts."

Kern is realistic to the point of offering Selling Techniques that talk about clothes, demeanor, promptness, making your software tangible, avoiding the hard sell, etc. For $10 you can read about many things you'd otherwise have to learn the hard way. Several of the chapters, such as Selling Techniques, or Selling Low-Cost Software, could alone be worth $10 to the beginner.

If you want to get into "making big bucks" by selling software, you can learn a great deal from these 106 pages. You may not get rich, but Kern can make the trip easier.

Computer Capers, by Thomas Whiteside. The New American Library, Inc., New York. 173 pages, paperback $2.25. 1979.

This is the paperback version of the 1978 hardcover book based on the *New Yorker* series of articles, and might must serve as a blueprint for certain people looking to supplement their incomes with a little overtime.

The subtitle is "Tales of Electronic Thievery, Embezzlement, and Fraud." In this handbook of computer crime, you learn all about the Equity Funding fraud, in which fake insurance records were generated on people who didn't exist, and the supposedly genuine policies were then sold to other insurance companies.

The story of the Union Dime embezzlement shows how to juggle bank passbooks. The chapter on "Electronic Thieves' Market" tells, among various fine schemes, how to rob a bank without a gun, by printing up deposit slips with MICR characters that route the deposit to your account. Then you just add these forms to the piles of blank deposit slips in the trays at the bank. The same chapter also details Jerry Neal Schneider's fun and games with AT&T, ordering truckloads of telephone equipment by knowing the proper ordering codes.

The subsequent chapters describe more complex computer crimes, and are a goldmine for the sticky-fingered. My favorite is the ploy Donn Parker also described in his **Crime By Computer,** another fine handbook: the salami or thin-slice-at-a-time technique, "reliance on tiny increments, sometimes literally only a fraction of a penny at a time." One way is to round down instead of up, and then divert the fraction of an penny to your account. "Quietly accumulating year in and year out, these fractional sums can mount handsomely."

Most of us, alas, don't work in areas where we can make useful application of the principles Whiteside describes. But for those who do work within electronic reach of the moolah, this book is a small investment that could be worth literally millions.

From the Counter to the Bottom Line, by Carl Warren & Merl Miller. Dilithium Press, Box 92, Forest Grove, OR 97116. 306 pages, paperback $12.95. 1979.

The back cover says this book "is written for the businessman who is attempting to find out what microcomputers can and cannot do for him." Almost a third of the text, 124 pages, is devoted to describing five basic accounting systems in detail: inventory and purchasing, billing, accounts receivable, accounts payable and general ledger. These five chapters are written in very plain English, with comments on various ways of solving accounting problems, and illustrated with many printouts made to look like CRT displays.

The first chapter, Should You Automate?, contains several questionnaires, with almost 100 questions, to help a businessman decide how to answer the question.

After a chapter on how a typical small business installed a computer, there's a chapter giving an overall view of data processing and of the five accounting systems, and a chapter on converting from a manual to a computerized system.

The appendices provide flowcharts and some menus for the five accounting systems, a long assembly-language routine for output to a reader/punch, various short routines, an index to hardware and software suppliers and a dozen pages on initializing a MECA operating system.

This may well be the best book at this price on acquainting the businessman with the ABCs of computerization, aside from the appendices, which are mostly 80 pages of filler.

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The record is available for $6.00 postpaid ($7.00 foreign) from Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

Z-80 And 8080 Assembly Language Programming, by Kathe Spracklen. Hayden Book Co., Inc., Rochelle Park, NJ. 174 pages, paperback $7.95. 1979.

Kathe and Dan Spracklen may be best known as the authors of Sargon, the computer chess program. According to the preface of her book, "we wanted to share what we had done in creating Sargon, and for many potentially gifted programmers there seemed to be a desperate lack of suitable introductory material... What I wanted was a book that taught Z-80 assembly language as a *first* assembly language."

And yet, after two elementary chapters, on introductory remarks and binary arithmetic, she gets right into flags and the stack pointer, without much preliminary text at all, in a chapter on Where Is My Variable? By the fifth page, she presents the full chart of op codes for all register-to-register moves, and is moving so fast that unless you already know something about assembler, you may well get lost by page 24.

The remaining chapters are on logical operators, jumps and loops, Bit Fiddling and Message Making, data structures, BCD arithmetic and When Time Is Important. This last is a short chapter on optimizing program development time and on minimizing machine execution time. When mnemonics are shown, they're given in both 8080 and Z-80 mnemonics.

The remaining 66 pages are appendices that provide an instruction summary, 8080 and Z-80 disassemblers, answers to the exercises given at the end of each chapter and an index.

Although this book has some good material, a better one by far is Lance A. Leventhal's **Z80 Assembly Language Programming**, published by Osborne & Associates at $9.50, and to be reviewed here at a later date. In Dr. Leventhal's book, you get 650 pages of lean meat, as compared with Mrs. Spracklen's 102 pages of so-so-text and 63 pages of filler.

By the way, even Intel uses both Z80 and Z-80.

QWIKTRAN, by C. Kevin McCabe. Dilithium Press, Box 92, Portland, OR 97116. 235 pages, paperback $8.95. 1979.

This book's subtitle is "Quick FORTRAN for Micros, Minis and Mainframes." QWIKTRAN is described in the book's glossary as "A minimal subset of ANSI FORTRAN IV allowing simple programs using a small number of command types." Nothing is said about who originated QWIKTRAN; presumably it wasn't the author.

The book starts simply, introducing Fundamental Concepts such as algorithms and flowcharts, in a conversational and colloquial style. After short chapters on Programming Languages and Numeric Processing, Simple Programming is introduced, starting with a short program that finds the grade average for each of 250 students. Subsequent chapters, on Input/Output and Using QUIKTRAN, present more commands along with short programs using them.

The following six chapters are on QWIKTRAN+, a "slightly larger subset" of FORTRAN IV, getting into Numeric Forms And Initialization, Character Manipulation, Subscribed Variables, Automatic Loops, Subprograms and Multi-Dimension Arrays. Here, also, the language is kept simple and the programs short.

The last three chapters present several additional commands that can simplify what would otherwise be complicated QWIKTRAN+ routines. The chapters are on Additional FORTRAN Statements (computed GOTO, arithmetic IF, blank COMMON, etc.), Logical And Complex Variables and Advanced I/O.

For a well-written, easily understood work on QWIKTRAN, this would be hard to beat. The book has very few program outputs, but this is a minor shortcoming in comparison with its many virtues.

The First Computer Design Coloring Book, by Stanley Baxendale. Harmony Books, div. of Crown Publishers, Inc., New York. 85 pages, paperback $4.95. 1979.

You can give this book to a child and let him color the designs, which were produced on a plotter controlled by a Tektronix 4051 and programs in BASIC but, unless he has a very steady hand and a great eye for color, the results won't come anywhere near the nine colored designs on the cover, which are quite pretty. Or you can appreciate the designs as fine examples of computer art. Or try to copy them on your system, if you've got a plotter with good resolution.

The designs are of eight different types: planetary motion: orbits (single continuous curves); planetary motion: patterns (three-dimensional); logarithmic spirals (multiple growth-curves); spherical mapping (graph paper with hemispherical bulges); tesselation (mosaic patterns); kaleidoscope (complex polygons); variations on traditional Japanese motifs; and circles in squares.

The book might be of more interest to computer enthusiasts if the programs for creating the 85 designs were included, but that would probably double or triple the size — and the price — of this attractive book that looks just as good on your coffee table as in the children's playroom.

The designer/author is a professor of mathematics, statistics and computer science, and currently teaches graduate courses in computer graphics at Rutgers University.

Guidelines for Selecting and Implementing Small Business Computers, by Philip M. Wolfe, William E. Dickson, and Lee W. McMorries. School of Ind. Eng. & Mgmt., Oklahoma State Univ., Stillwater, OK 74074. 109 pages, paperback $4.95. 1979.

The preface notes that "this text is written to be an aid for the small businessman in understanding computers . . . It is not meant to be a comprehensive text on computers. Rather, it is intended as a short concise book for those who do not have time to read one that is more thorough."

The ten chapters of this 8½-by-11-inch book present a clear picture, in simple, non-technical language, of what computers are all about. Large drawings are used to show, for example, just how golfball, daisywheel and dot-matrix print mechanisms work.

The chapters cover computer systems, system software, application programs, evaluation of software packages, system justification, implementation considerations, turnkey systems, service bureaus and timesharing, use of consultants and future technology.

The first appendix provides a helpful system-selection checklist; the second, a glossary of computer technology.

Reasons are given for selecting various alternatives, such as timesharing versus a service bureau. The book is full of helpful advice such as "Bigger is not necessarily better in terms of small computer vendors."

The text is enlivened by the use of 20 cartoons taken from **Creative Computing's Colossal Computer Cartoon Book**. The book was partly financed by program IMPACT of the Higher Education Act of 1965: Title I, and is sold on a non-profit basis at the cost of reproduction. Checks should be made out to the university, not to the authors.

Every small businessman considering the use of a computer can profit from this book. Any of the ten chapters is alone worth several times the price of the whole book.

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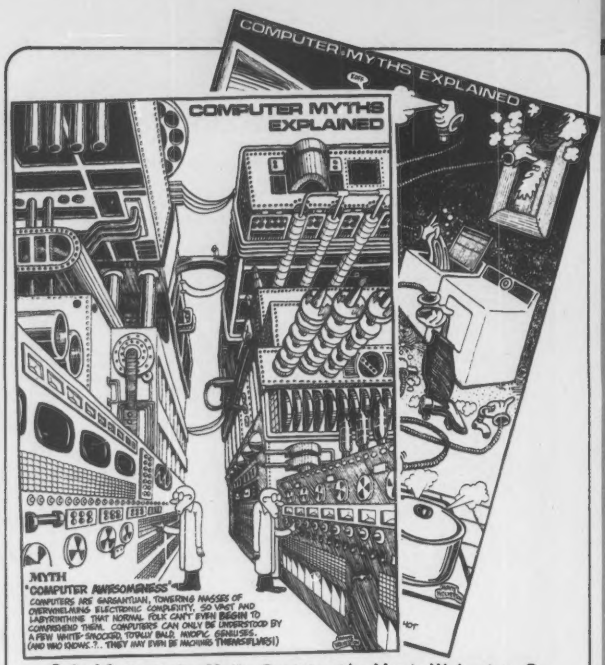

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Introduction to Personal Computing, by Alltech Publishing Co., 212 Cooper Center, North Park Drive & Browning Road, Pennsauken, NJ 08109. 76 pages, paperback $25. 1978.

The subtitle is "A Special Business Automation Report," Alltech being publishers of Business Automation, a reference service.

This is a collection of data about personal computers that you could assemble yourself from catalogs. But Alltech has done the work for you, providing, on 8½-by-11-inch pages, "product profiles of selected personal computing vendors," about 70 of them. Some make computers, including Commodore, Heath and Vector Graphic. Others make peripherals, including Axion, Braemar and Micro-Term. And a few others are no longer in business.

The material is presented without comment, giving specifications and prices of hardware, available software and the firm's address and telephone number. The entries are from several paragraphs to several pages long, without photos.

The profiles are preceded by a four-page table showing which of the firms offer products in five categories. Three pages list publications, including "computer-industry trade magazines" such as *Datamation* and *Spectrum*, "personal computing trade magazines" such as *Creative Computing*, newsletters such as ON-LINE, and a dozen publishers of books and texts. The last five pages are a directory of the vendors, repeating the names, addresses and phone numbers given in the profiles.

The $25 price is high, even though a lot of information is provided in handy form. Most computerniks have at least half this material in the form of manufacturers' literature. With photographs (there isn't a single one in these 76 pages), the report might be worth about $10, maybe $15.

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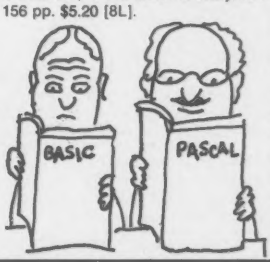

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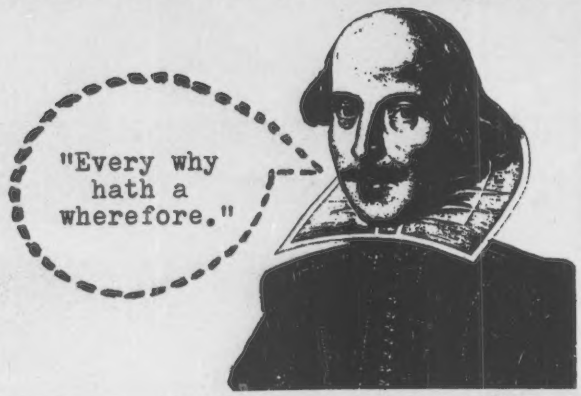

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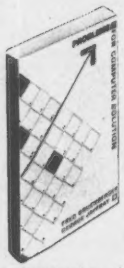

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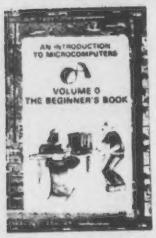

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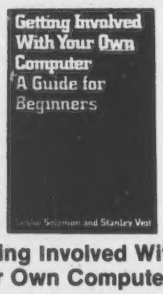

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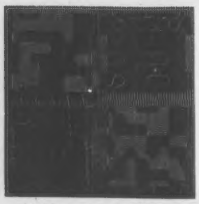

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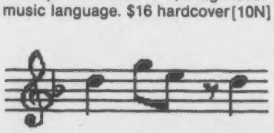

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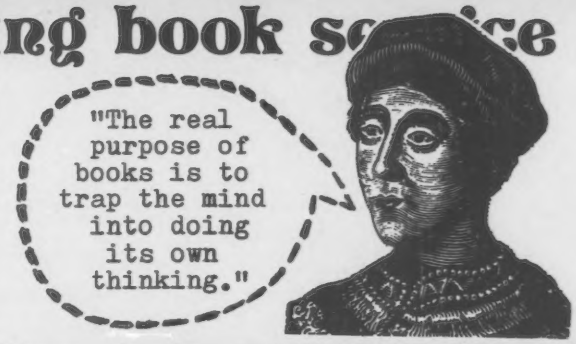

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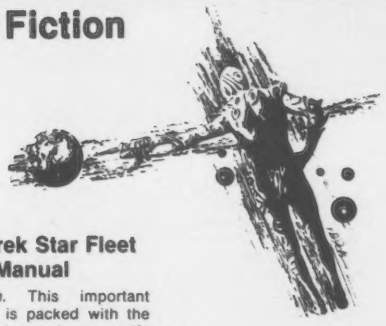

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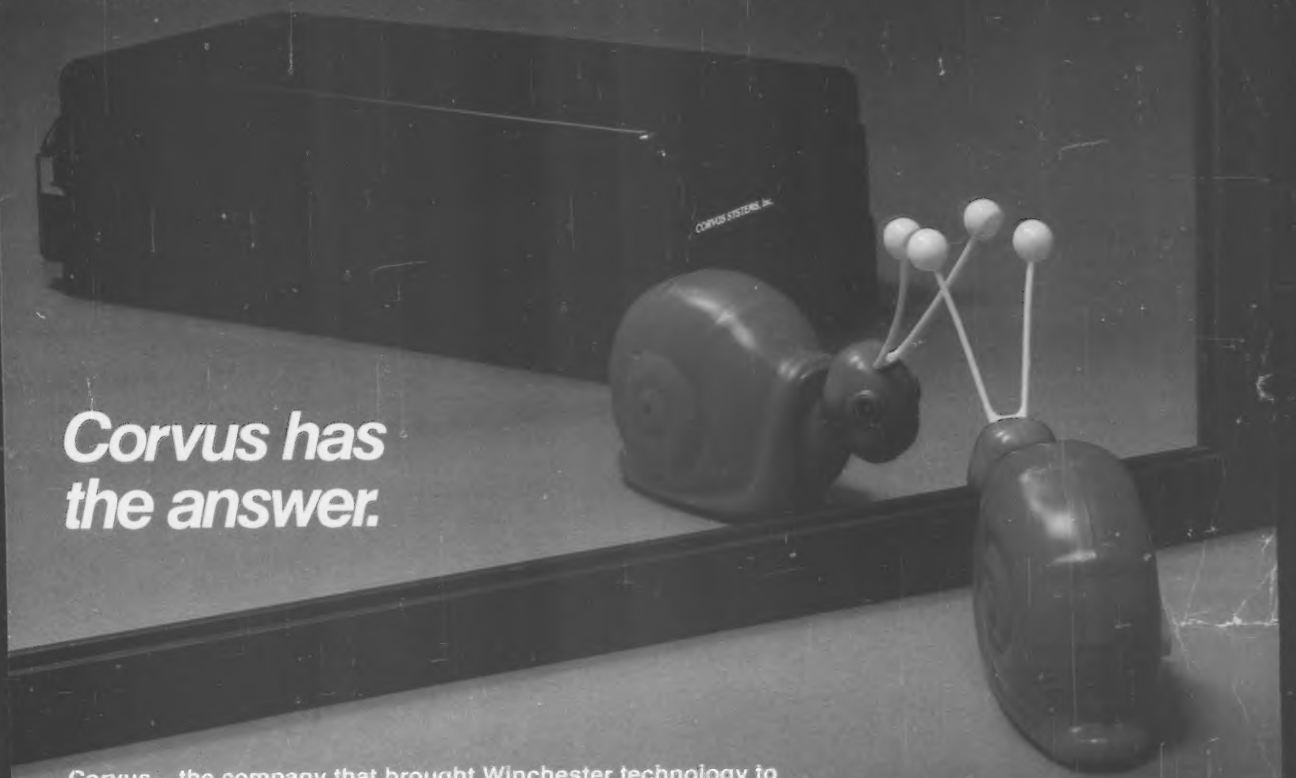

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